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The Province of Alberta

PETROLEUM AND NATURAL GAS CONSERVATION BOARD

IN THE MATTER OF THE GAS RESOURCES PRESERVATION ACT

AND IN THE MATTER of a Joint Hearing to determine various questions
relating to the proposed Export of Natural Gas from the Province of Alberta.

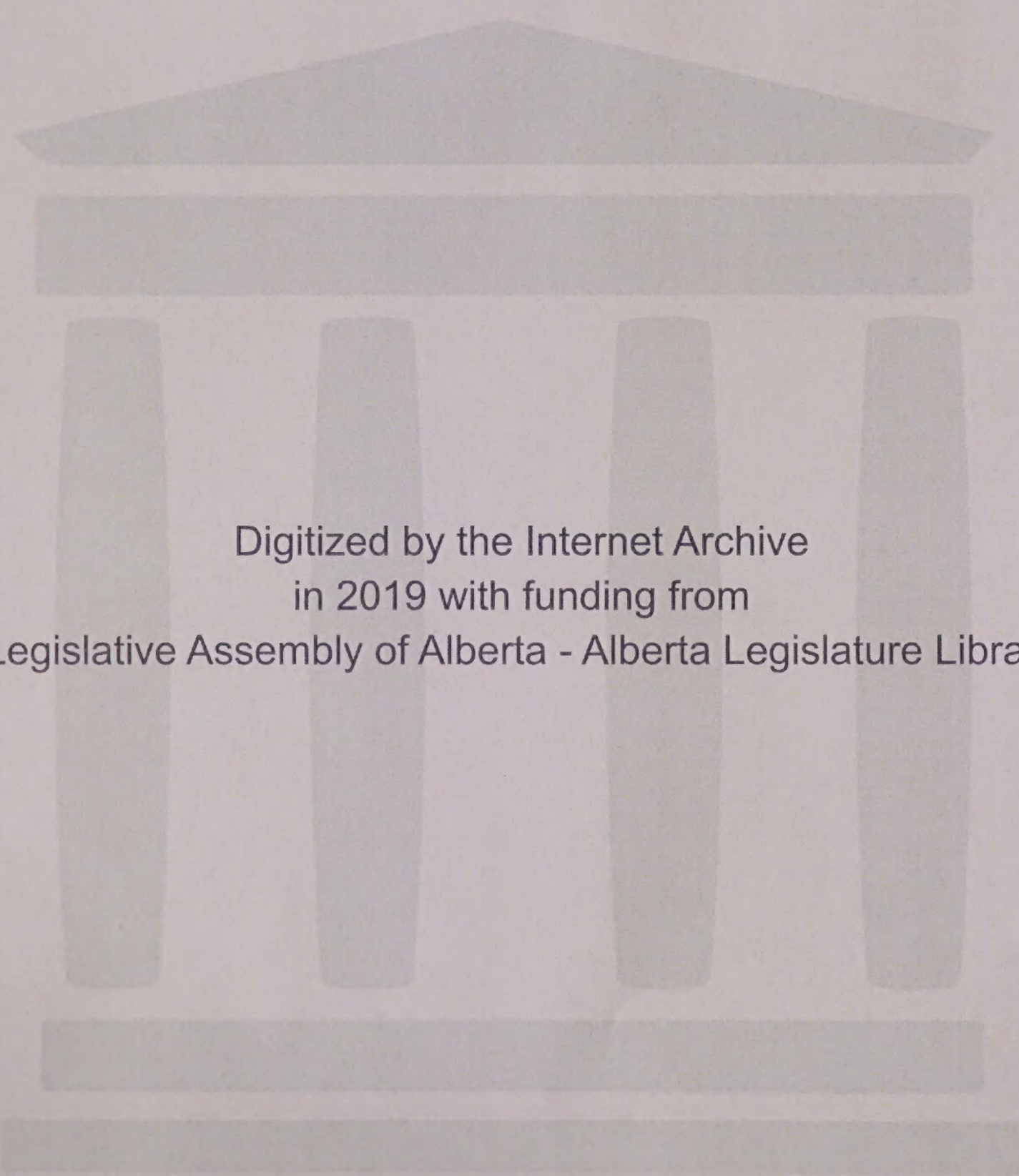
I. N. McKinnon Esq., Chairman

D. P. Goodall Esq.

Dr. G. W. Govier

Session: October 4th, 1951.

Volume 16.



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MR. STEER: May I mention one small matter, sir. Mr. Davis is very anxious to have a correction made on page 1344 of yesterday's transcript where he said he thought the price of oil was about where it was in 1940. As a matter of fact, he checked it up and finds that the price in 1940 was \$1.40 and in 1950, \$2.65 for East Texas.

MR. FENERTY: Mr. Chairman and Gentlemen, we would like to present a submission by Canadian Gulf Oil Company with respect to the Pincher Creek field. We would like to call Mr. Gray, Vice-President of Gulf.

THE CHAIRMAN: It will be Exhibit 40.

SUBMISSION OF CANADIAN GULF
OIL COMPANY RE PINCHER CREEK
MARKED EXHIBIT 40.

FLOYD L. GRAY, having been duly sworn, examined by Mr. Fenerty, testified as follows:-

Q I believe Mr. Gray's qualifications were previously accepted by the Board. I would ask Mr. Gray to proceed with the submission.

A Since the previous submission, presented in November 1950, another well -- Bonertz No. 1, located in Lsd. 1, Sec. 15, Twp. 4, Rge. 29 W. 4th has been completed in the Pincher Creek field. This well encountered the top of the Madison limestone (the productive formation) 207 feet higher than Pincher Creek No. 1 and 513 feet higher than Walter Marr No. 1. Preliminary tests have been made and the static bottom hole pressure was found to be 4,952 psig. The well

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was produced at a stabilized rate of substantially 30 MMcf/day, for a period of six hours through 2-7/8" O.D. tubing. During this test the tubing head back pressure was 850 psig., and the flowing bottom hole pressure was 4,369 psig. This is a draw down of only 583 psi. or approximately 11.7% of the reservoir pressure. It is obvious that Bonertz No. 1 is a very high-capacity well.

As was done in the other wells, Bonertz No. 1 was cored through the Madison limestone section. Analyses of the cores have not yet been completed, but were examined carefully by geologists at the well. Such information, coupled with other developments since the last submission, lend confidence to the accuracy of reserves previously submitted to the Board for the Pincher Creek field. Those estimates, based on measurement at 14.4 psia, and 60 degrees F., amounted to a total gross gas reserve to a depletion pressure of 100 psi, of 1.65 trillion cubic feet of high pressure separator gas, and a net marketable gas reserve of 1.32 trillion cubic feet.

It should be emphasized that the above figures are based on the gas available from the high pressure separators which has been adjusted for shrinkage due to condensate production. In addition to the high pressure separator gas, there will be gas available from the low pressure separators and from the stock tanks. This low pressure gas can be utilized for field and plant fuel requirements. It is for these reasons that we believe a 20% shrinkage factor for the high pressure separator gas is quite reasonable and adequate.

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It should be recognized that the estimation of reserves for a pool like Pincher Creek, which does not have a production history, is largely a result of mathematical calculations. Canadian Gulf has deliberately been conservative in the values used in these calculations but does not take issue with the larger reserves which have been submitted by other estimators.

The Bonertz No. 1 well contained all the productive section of the Madison limestone above the gas-water contact, and accordingly confirms the previously submitted productive area of the field, amounting to approximately 17,250 acres. It will be recalled that somewhat arbitrary boundaries were placed on the north and south ends of the Pool even though there was no definite seismic data showing closure at these boundaries. Accordingly the Pool area may well be considerably larger than the 17,250 acres currently considered as productive.

The Walter Marr No. 1 well, located in the northern portion of the field, has been produced for a period of five months at a rate of approximately 3 MMcf/day. This production was for the purpose of conducting a pilot test to evaluate equipment and materials and to determine the most efficient operating methods. During this period the production rate has been continuous except for only minor interruptions, totaling two days required to make changes and inspect test equipment. These tests are still in progress, but at a reduced rate of flow in order to further evaluate materials and chemical treatment. In view of this experience, it is believed that the operating difficulties

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have now been overcome.

The results of production tests on the Pincher Creek No. 1 and Walter Marr No. 1 wells have previously been submitted to the Board. Those tests indicate that both of these wells are capable of very high producing rates. The recently completed test on the Bonertz No. 1 well indicates that this is also a high capacity well. The widely spaced location of these wells and the uniform well to well characteristics of the reservoir lends confidence to previously submitted estimates of reserves and producing area, and lends assurance that future wells in the field will have correspondingly high delivery capabilities. For wells of this type it appears to be entirely practicable and feasible to produce during routine operation at rates of twenty million cubic feet per day or more.

Field deliverability is largely a question of the number of wells to be drilled, and the number of wells to be drilled is governed by economics and available markets. Another well in the Pincher Creek pool has now been authorized and operations started. Accordingly, the pool will have a substantial deliverability even before construction of gas transmission facilities is commenced.

In addition to the reserves of gas, there are very substantial reserves of sulphur that can be extracted from the gas produced from the Pincher Creek field. The recoverable sulphur reserves are estimated to be five million long tons, and recovery will amount to approximately 3.15 long tons of sulphur per million cubic feet of produced gas.



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According to the Dominion Bureau of Statistics, sulphur production in Canada for the year 1950 amounted to 282,000 long tons. The reported net imports (imports minus exports) of sulphur to Canada during the same year (largely from the United States) amounted to 247,000 long tons. Thus it can be seen that the sulphur recovery to be realized by producing the Pincher Creek field, at a rate of two hundred million cubic feet per day, would amount to 230,000 long tons per year and would, in a large part, eliminate the dependency of Canada on sulphur imports.

Also in addition to the gas reserves, there is a total reserve of liquefiable hydrocarbons amounting to forty-eight million barrels. The condensate portion is estimated at twenty-five million barrels and propane and heavier, including natural gasoline, is estimated at twenty-three million barrels. The proportion of propane and heavier to be recovered will be determined primarily by the market in relation to the cost of the plant facilities required.

Before marketing gas from the Pincher Creek field, processing for the removal of hydrogen sulphide and at least a portion of the liquefiable hydrocarbons will be necessary. In order that the processing plants operate at reasonable efficiency and be economically feasible, it is essential that the Pincher Creek field be assured of a relatively uniform producing rate. For economical operation, the field should be assured of a producing rate of one hundred and sixty-five million cubic feet per day and could produce economically upwards of two hundred million cubic feet per



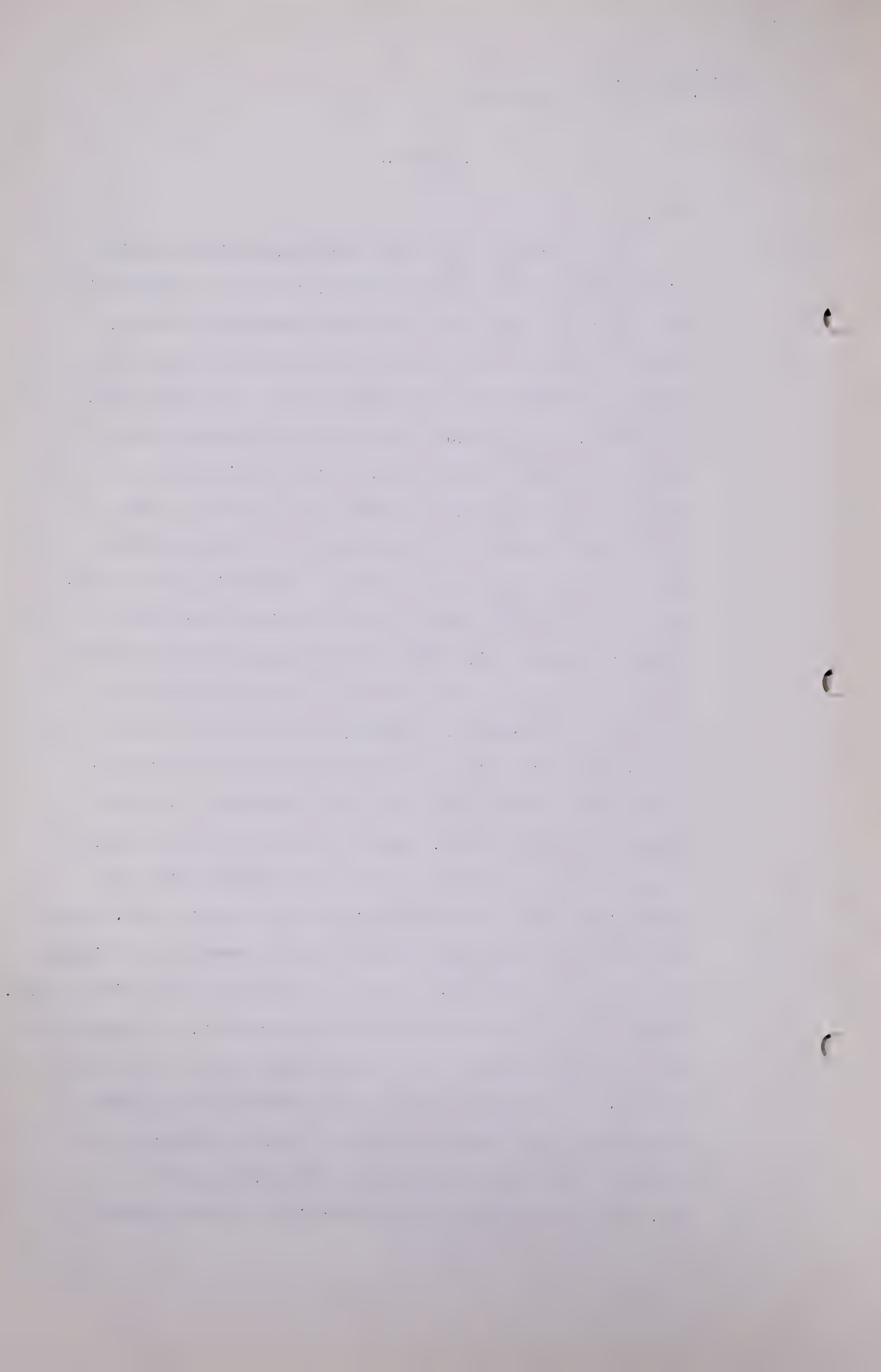
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day.

Because of the very large expenditures which will have to be made for drilling, for plant construction and for the installation of a field gathering system, Pincher Creek is not a field that can be developed and operated economically on a small scale. Canadian Gulf, therefore, had to assure itself that an adequate market exists, and this it has done. It is believed that a market exists which will require and which will take between one hundred and one hundred and fifty million cubic feet of gas a day as soon as a pipeline can be completed. The market should expand rapidly thereafter to a point where it will take two hundred and fifty million cubic feet a day or more within a few years after the pipeline is completed. Canadian Gulf believes that in order for a pipe line to be built that the distributor serving the market will have to be convinced as to the adequacy of the supply. Also in order to be financed, the project will have to be assured of a supply which will approximate at least the initial market requirement. Anyone who will have made arrangements for the purchase of Pincher Creek gas can give such assurance. Canadian Gulf Oil Company, having been assured of a satisfactory market, is prepared to make such expenditures and arrangements as are necessary to develop the Field and schedule the construction of the necessary plants and facilities to give assurance to the pipeline and to the market of an adequate supply.

Q Mr. Gray, you refer to deliverability from the field. I



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want to ask if you made any calculation if a market, say, of 150 million cubic feet of gas per day were allocated to the Pincher Creek field, how soon could deliverability from the Pincher Creek field be brought to this figure?

A It requires about 10 months to complete a well in the Pincher Creek field and it would be quite simple to have a deliverability of 150 million within one year.

Q Depending entirely on the market requirements?

A That is right.

Q Up to that requirement, you believe that this field could be developed to meet the market requirements within a year up to that figure?

A I do.

Q What about 200 million?

A 200 million could be made easily within two years.

Q Do you think you could keep the development of deliverability up to any possible pipe line construction's schedule, to serve such an extended market?

A A pipe line, in order to be built will have to have an allocation of steel and priorities and I believe that the plant that would be built in Pincher Creek would fall in the same priorities.

Q You think you could keep up with any demand within the feasible limits of production that you have given here today?

A Yes, I do.

Q This submission has been limited solely to the Pincher Creek field. Perhaps it is unnecessary but can you tell the Board if the interests of Canadian Gulf in gas production

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is confined to the Pincher Creek field?

A No. Canadian Gulf has interests in most of the prospective areas of Alberta. It is carrying on a very extensive exploratory campaign at the same time. It has 21 wells at this time and in addition operates and has added an additional well in the Pincher Creek field. Out of a total of more than 4 million acres in the Province, they have holdings in the Peace River area amounting to over 2 million acres and has an interest in some 800 acres in the adjoining British Columbia area. It has a well drilling a short distance from Peace River which is now drilling below 5400 in the D-1 formation. It has 12 geophysical parties and 8 core drills in operation in the Province. Of those three geophysical and 2 core drills are operating in the Peace River area. It is believed this extensive exploratory program should result in substantial increases in gas discoveries.

Q Now I do not think I am going to elaborate in direct examination on the various facts that have been brought out here, leaving them to cross-examination, but I might ask you if this report, how up-to-date does this bring your information on Pincher Creek?

A It is substantially today.

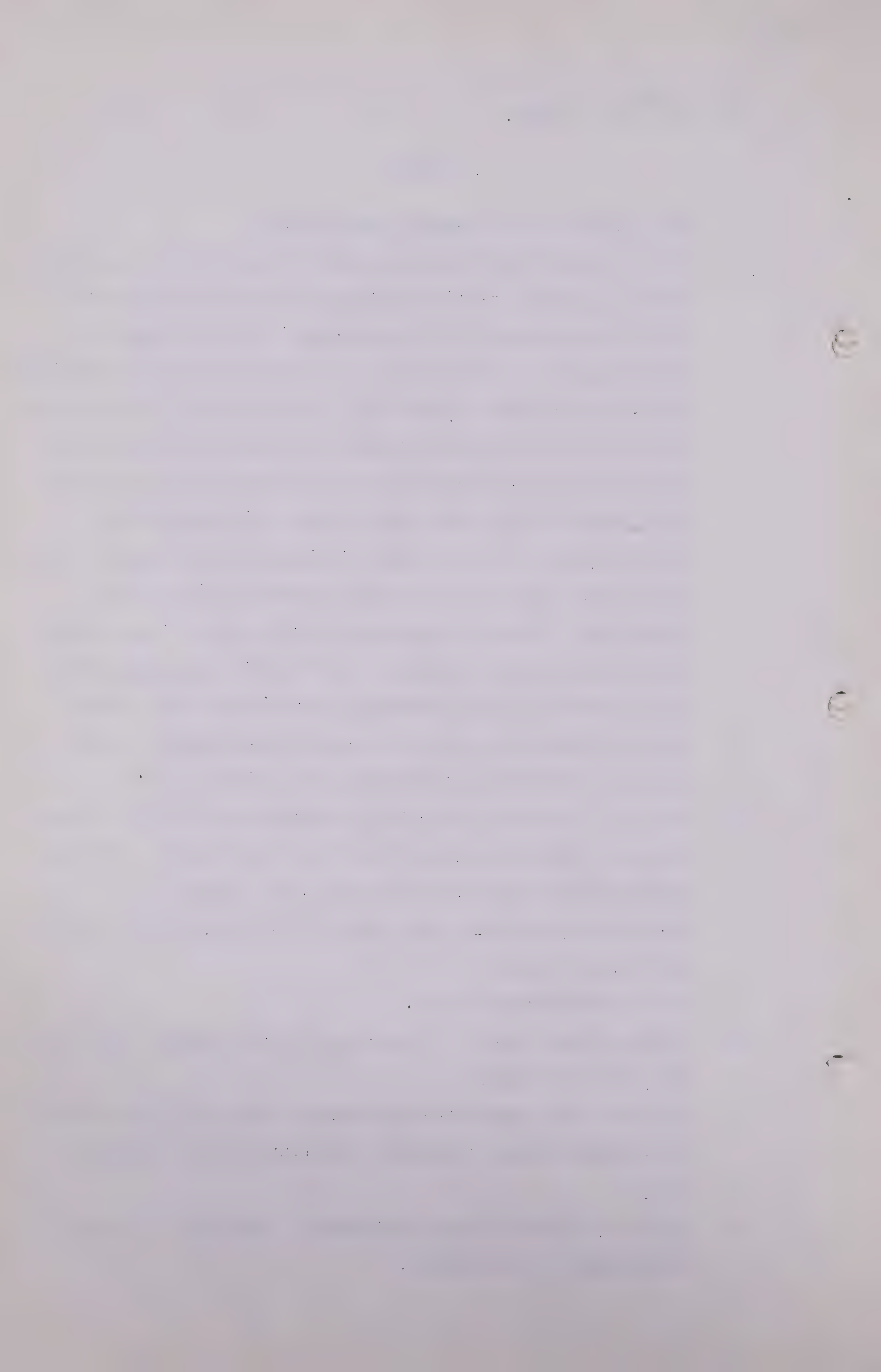
Q Substantially today? I understood it was within a day or two?

A Yes, that is right.

Q And that this report incorporates all the information based on the most recent information available to the company?

A Yes.

Q That is, the most recent information available to anybody with respect to the field?



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A That is correct.

CROSS-EXAMINATION BY MR. McDONALD:

Q Sir, I have a few questions. In regard to Pincher Creek field, Mr. Gray, you were the witness here last year, were you not?

A Yes, sir.

Q Now, would you tell me if this Bonertz No. 1 well is located on the high or top of the structure as shown by your seismic maps?

A Yes.

Q It is? I take it that the Pincher Creek No. 1 and the Walter Marr No. 1 are also on the top of the structure?

A No. There was, I think, 207 feet lower on Pincher Creek No. 1 and 513 feet lower on Walter Marr No. 1.

Q You did the seismic work, of course, over a span of years?

A Yes.

Q And I understand it was very detailed?

A Worked and re-worked.

Q And was Walter Marr No. 1 and the Pincher Creek wells, were they located on the high as shown by your original work?

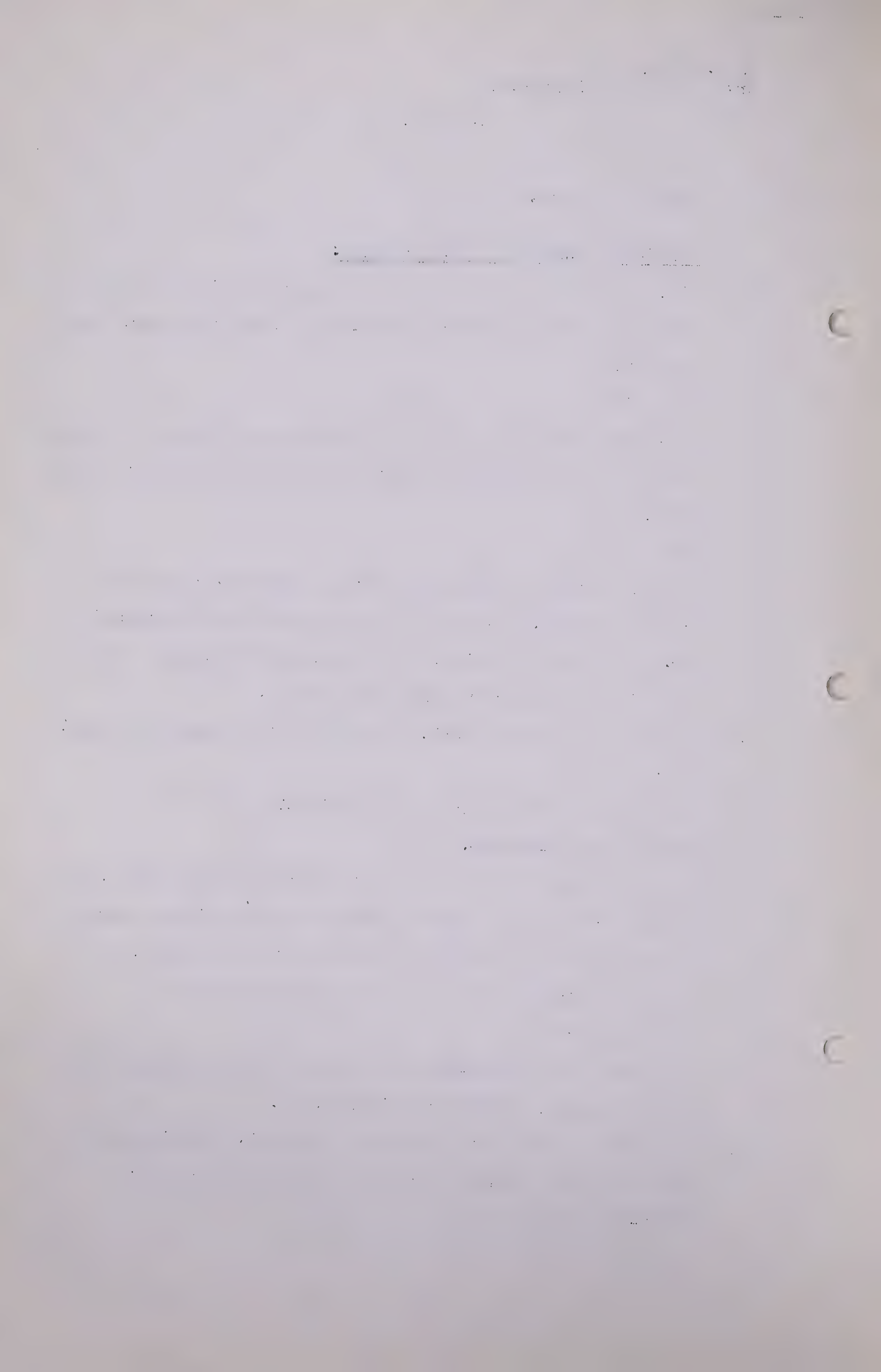
A It was not on the highest portion of the structure, no.

Q As I understand it was not on the highest point?

A That is right.

Q How about on an East-West line across the structure, was it on the high of that particular. . .

A I am sure it was not, but let me check it. It is almost 800 feet lower than the crest of the structure on the East-West line.



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Q And that is the Gulf Marr you are speaking of?

A Yes.

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Q How about the Pincher Creek No. 1?

A Pincher Creek No. 1 east-west is almost 600 feet lower than the crest.

Q 600 feet lower than the crest?

A Yes.

Q How is that related in mileage? Will you take the Gulf Marr, for instance, at the top, how far would that be from the Gulf Marr to the east?

A To the highest portion?

Q Yes?

A About a mile and a third.

Q And similarly with the Pincher Creek?

A Just about an even mile.

Q How did you work out with your Bonertz well?

A Bonertz is about 400 feet lower than the crest and it is just about a mile, a little less than a mile to the crest.

Q A little bit less than a mile to the crest?

A Yes.

Q How does your outline there show? What is the height of the crest to the Bonertz well, what would be your prognosis there?

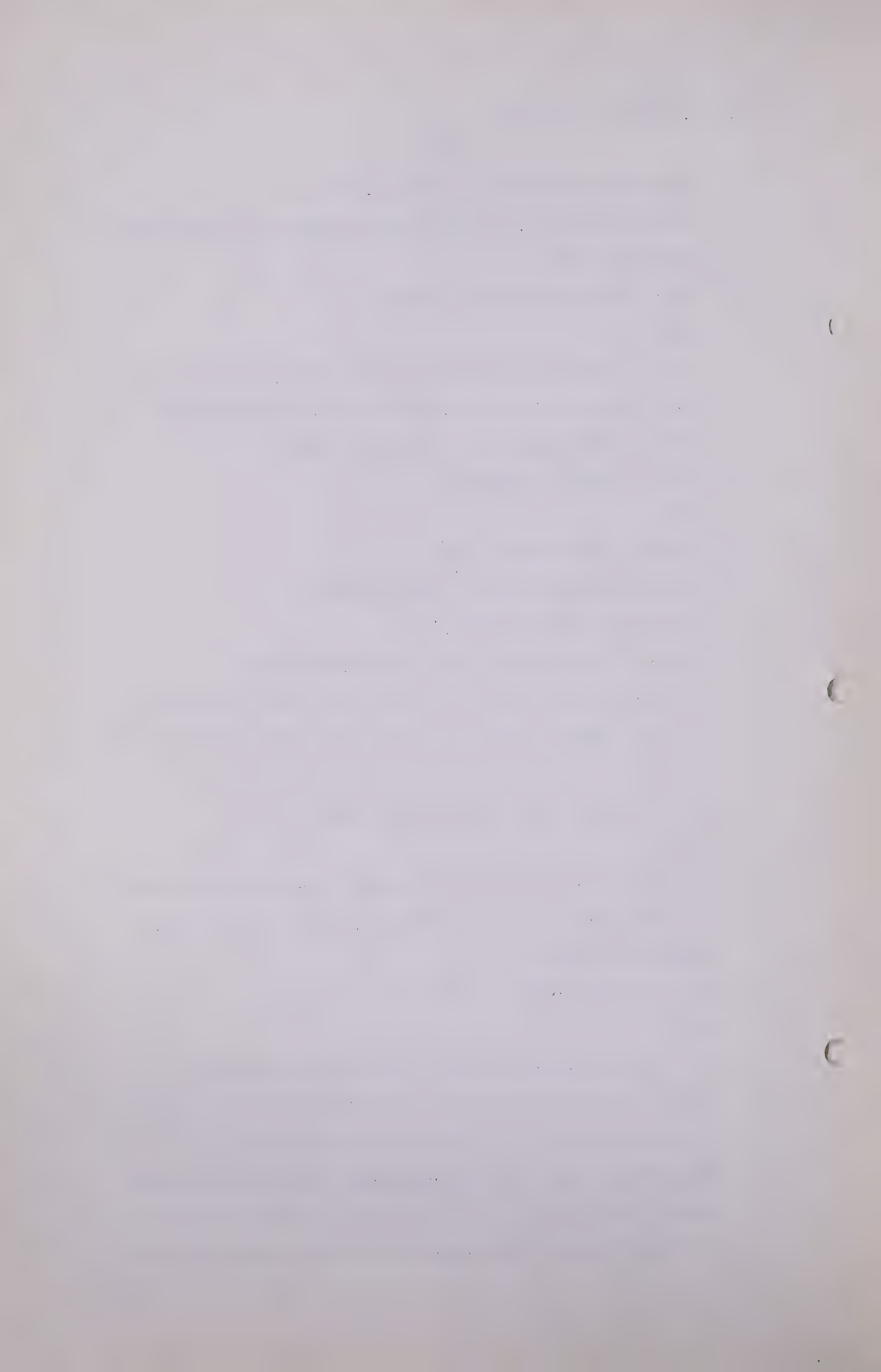
A You mean the crest of it?

Q Yes?

A We show the crest as minus 6900 below sea level.

Q In the Bonertz well you got the limestone at - I do not know whether you have mentioned it or not?

A According to the geophysical map it should have been about 7200 subsea. I do not seem to have the figures on that, but the difference between the geophysical map



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and the actual subsea was about 125 feet. The well was about 125 feet lower than the geophysical map showed.

Q MR. C. E. SMITH: Which well is that?

A Bonertz No. 1. And that is a very close check.

Q MR. McDONALD: Your prognosis or your estimate before you started was that it would be 125 feet higher than it actually turned out to be?

A That is right.

Q And your estimates with regard to the other two wells, the Gulf Marr, were you lower or higher than your prognosis?

A I do not recall those figures, and I do not believe they are available here.

Q Yes?

A Additional work was done after those wells were drilled and the maps revised, and now they show the revised.

Q What would you say that your total closure is on the top of the limestone as indicated by the wells drilled to date?

A Using Bonertz No. 1 as being the crest, or do you want to use the crest shown here?

Q Let us take it with using Bonertz No. 1 first, and then taking it as shown on your map?

A About 1000 feet on Bonertz No. 1.

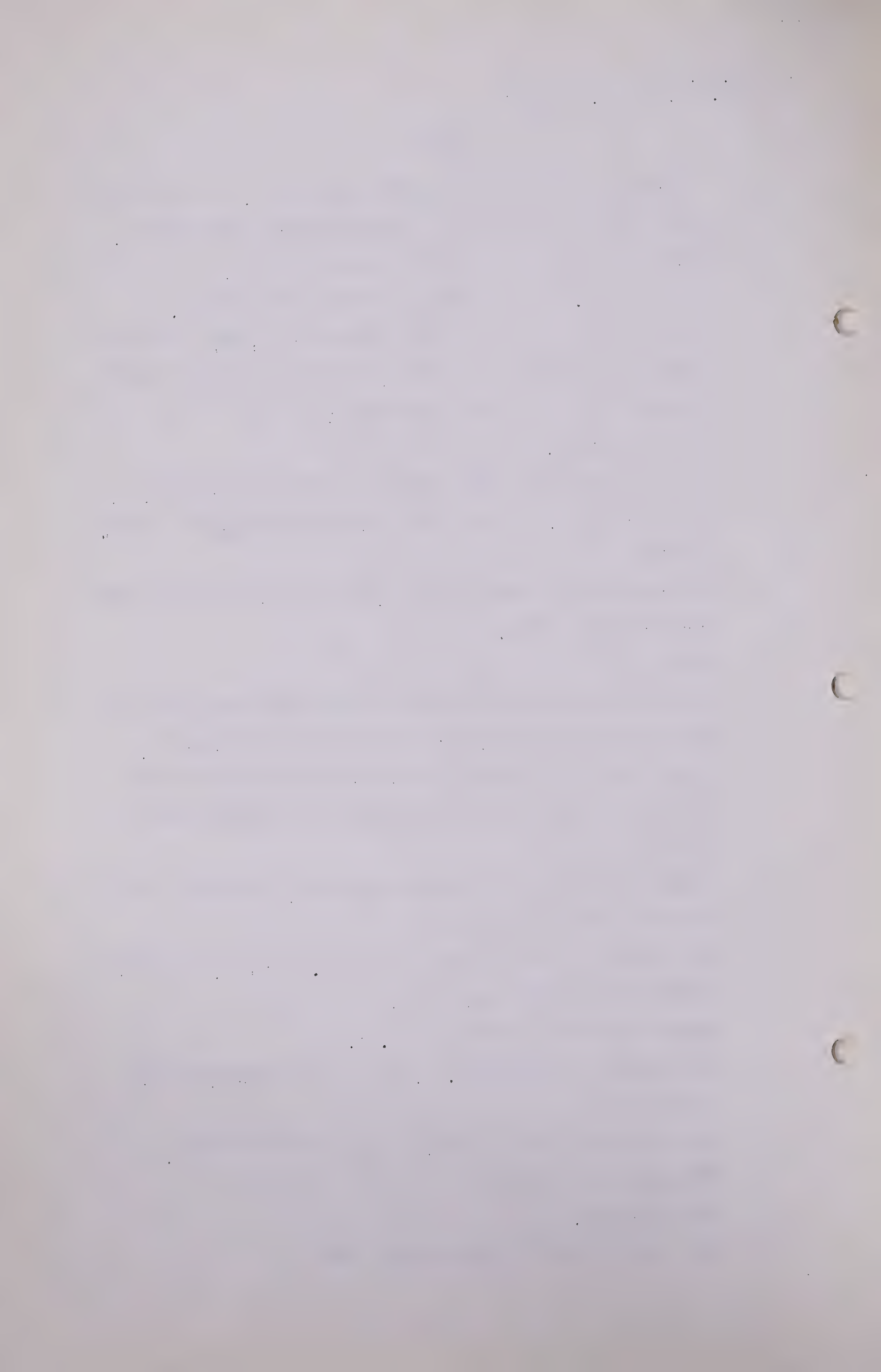
Q That would be Bonertz No. 1, and to the Schrempp well to the west?

A That would be down to the 8200 contour to the west.

Q The gas/water contact?

A That is right.

Q How does it look on your seismic map?



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A About 700 feet for Pincher Creek. About 300 feet for Marr.

Q About 1000 feet in the relatively north central section for the Bonertz well?

A To the greatest closure would be in the neighbourhood of 1300 feet, according to this map.

Q Yes. That would be in the vicinity of Gulf Bonertz well?

A Yes.

Q That is just north of the centre?

A It would be in section 14, just to the east of Bonertz.

Q Now, what is your estimate of the inclination of the west dipping beds, is it steep or is it gradual?

A It is rather steep. From Bonertz No. 1 to the west, a distance of about a mile and three-quarters, it dips 800 feet, no about 1000 feet.

Q And, similarly, in the Gulf Marr?

A In the Gulf Marr it is not quite as steep. It depends in which direction we go. If you go southwest it is quite steep. In a distance of half a mile it is 300 feet.

Q Yes?

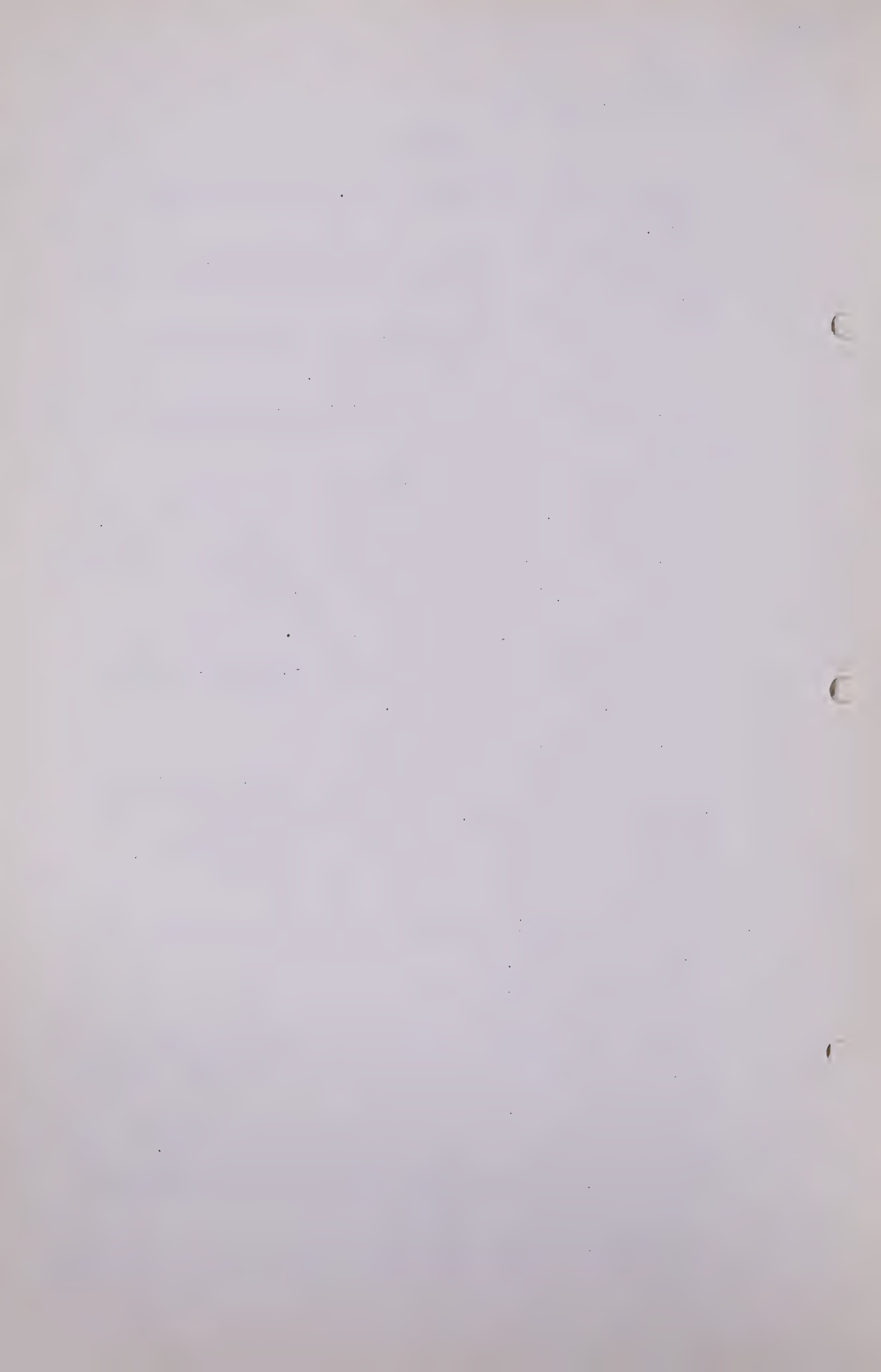
A If you go directly west it would take a mile and a half for that 300 feet.

Q And Pincher Creek?

A Pincher Creek would be about a mile and three-quarters - no, about a mile and a quarter to the edge, and I believe that was 700 feet.

Q What is your idea of the inclination to the east, on the east flank, either from the wells or from your prognosis with regard to the structure?

A It is fairly uniform. Starting on the Marr, if you go east,



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it is about a mile and a quarter to the crest, and about 600 feet.

Q Now, just a moment, so that I understand, Mr. Gray. You go a mile and a quarter. . . .

A A mile and a quarter.

Q . . . from the well to the crest?

A Yes, the structural difference is 600 feet.

Q Yes. And do you get your sole fault at that point?

A We show a fault along the northeast edge of the pool.

We have some faults shown along in the reservoir, but all of them have question marks on them, and each one of them, it would have been just as easily contoured regarding the dips that we have as to draw a fault in there. There is a saying, you know, that a fault sometimes shows a weakness in the geologist.

Q So that, as I understand you, you have not as yet drilled a well on the crest of the structure?

A That is right.

Q And you have not drilled a well on the east flanks, on the east flank, if there is any flank?

A No. It is bounded on the east by the fault.

Q It is bounded on the east by the fault?

A Yes.

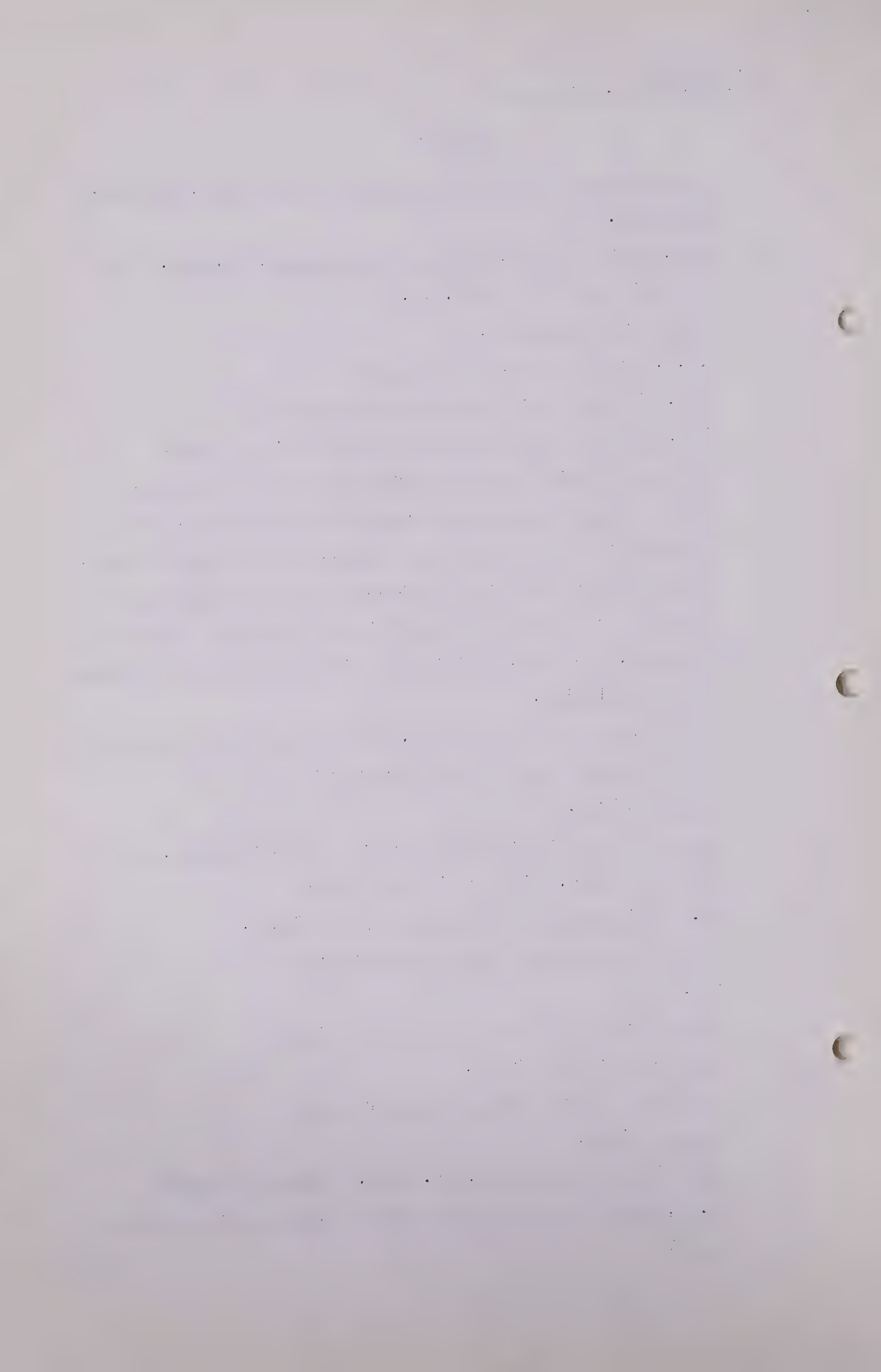
Q And the crest is practically at the fault?

A Very close to the fault.

Q As far as you can judge from your work?

A That is right.

Q There is one other item, Mr. Gray, taking the Bonertz No. 1, what is the distance from the Bonertz east to the crest?



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A To the crest?

Q Or to the fault? First to the crest?

A About a mile, just a little over a mile to the crest, and probably be about one-third of a mile on to the fault.

Q And the dip from the crest there to the fault is steep or gradual?

A It is still rather steep. It is some 300 feet.

Q Yes? In that mile or mile and a quarter?

A No, I beg your pardon. On Bonertz it is only about three-quarters of a mile to the crest.

Q Yes? And then how far to the fault again? One-third of a mile, I think you said?

A From the crest to the fault.

Q From the crest to the fault?

A Yes.

Q About one-third of a mile?

A Yes, about one-third of a mile.

Q Now, just to end it up there, what is your estimate of the productive area?

A 17,250 acres.

Q That is the areal extent?

A Yes.

Q I was thinking about the width of the productive area?

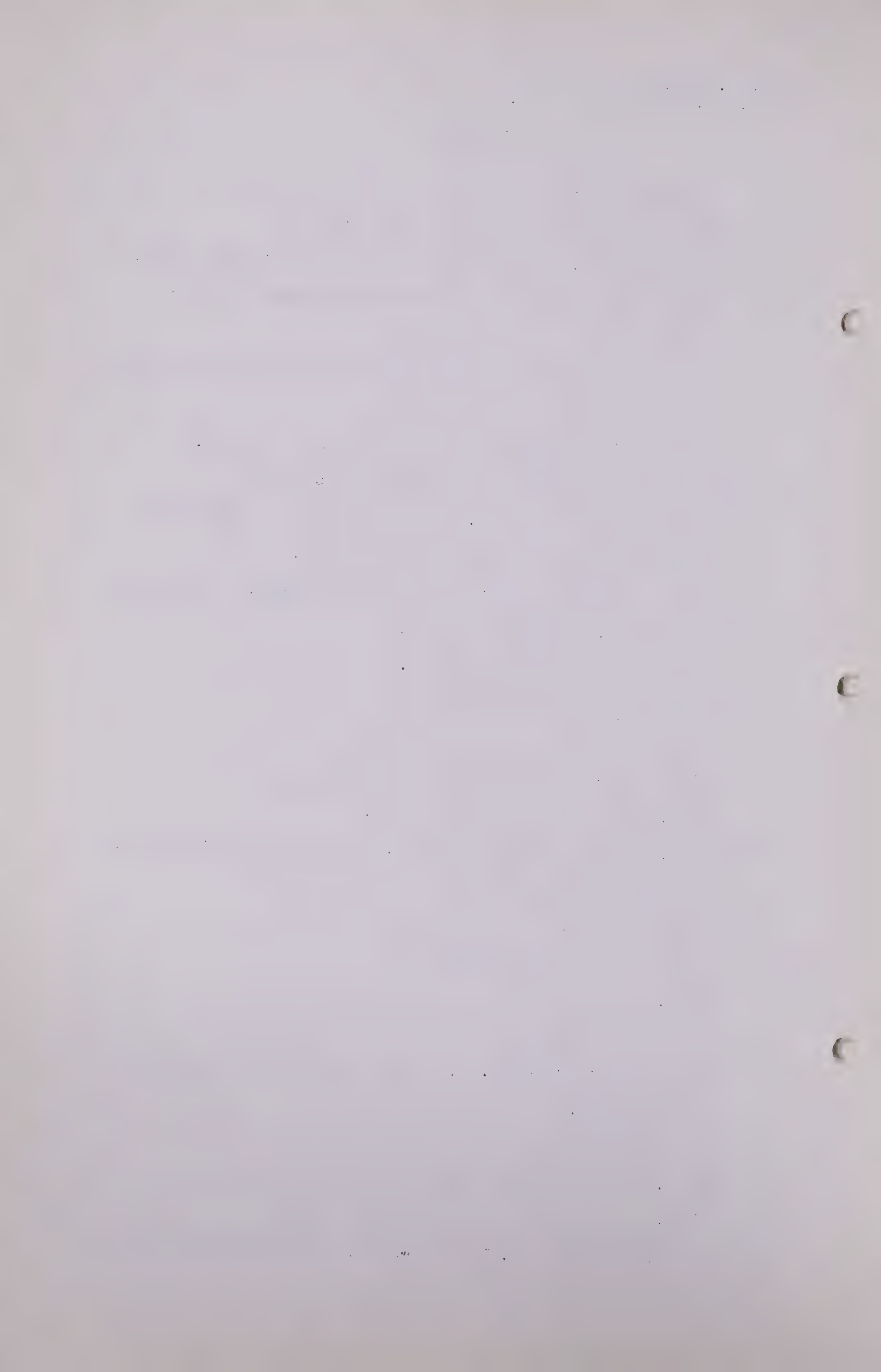
A At Pincher Creek No. 1, going east-west, it is about 2-7/8 miles.

Q 2-7/8 miles?

A Yes.

Q Yes?

A At the Bonertz No. 1, east-west, it would be about 2 $\frac{3}{4}$



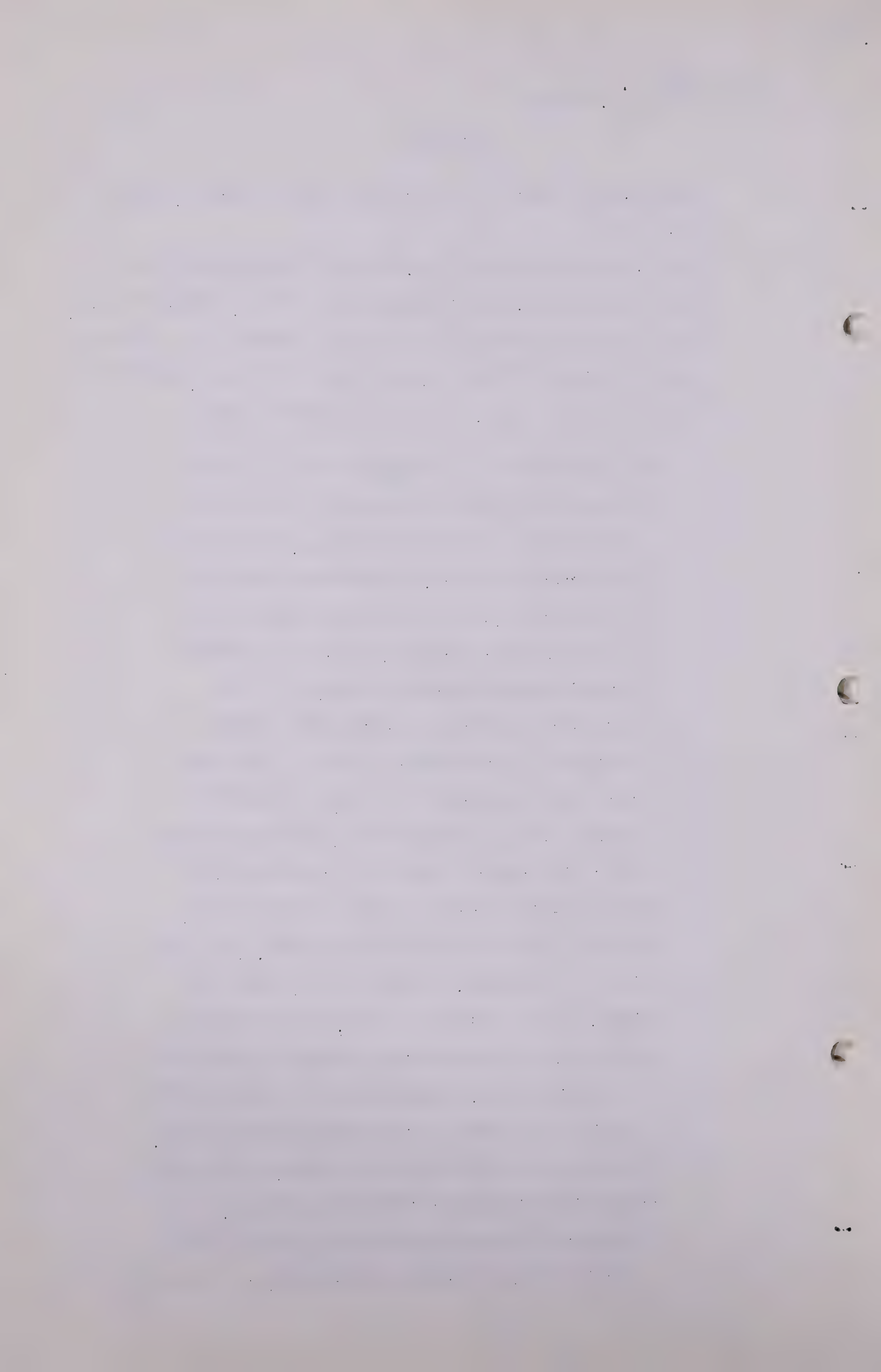
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c miles, and at Marr a little more than $2\frac{3}{4}$ miles, almost 3.

Q Well, I am interested, Mr. Gray, in the statement as contained in Dr. Hume's Report as of July, I think it is, 1950, I was wondering if you would comment on his discussion of Pincher Creek? I will read it to you, and you can then look at it. He says at page 245 that,-

"No information is available on the details of the Pincher Creek structure, but it is assumed that the limestone mass, which forms the structural core, is somewhat similar to the general type of foothills structures or to the limestone ranges, which are commonly strongly asymmetrical and faulted to the east with moderately dipping west flanks. The width of production on such a structure where the east flank is steep or vertical depends upon the amount of closure above the water line and the amount of inclination of the west-dipping bed. The steeper the dip and the less the productive closure, the less will be the width. Turner Valley owes its width, up to 3 miles or more, to the phenomenal amount of productive closure on the top of the limestone, from plus 782 to minus 4200 feet in the south to minus 4400, more or less, feet in the north end of the field, or a total productive closure of 5000 feet or more. Although such a great productive closure could occur in other foothills structures, it normally



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"would not be anticipated, and hence the common structural type is regarded as relatively long in relation to the width. The Moose Mountain Paleozoic outlier is an exception in that it is not sharply faulted off on the east side. The Pincher Creek structure has been shown to have a productive closure of approximately 500 feet and, therefore, is relatively narrow."

Now, would you change the data that he had? Would you care to look at it?

A I think I understand it, what he had to say.

Q Yes?

A I think the only thing that I disagree with would be the amount of productive closure. I think we definitely now have information that the closure would be more nearly in the neighbourhood of 1000 feet.

Q Yes?

A He said 500.

Q Yes, 500?

A Now, there is no east dip on this structure as near as we can find out.

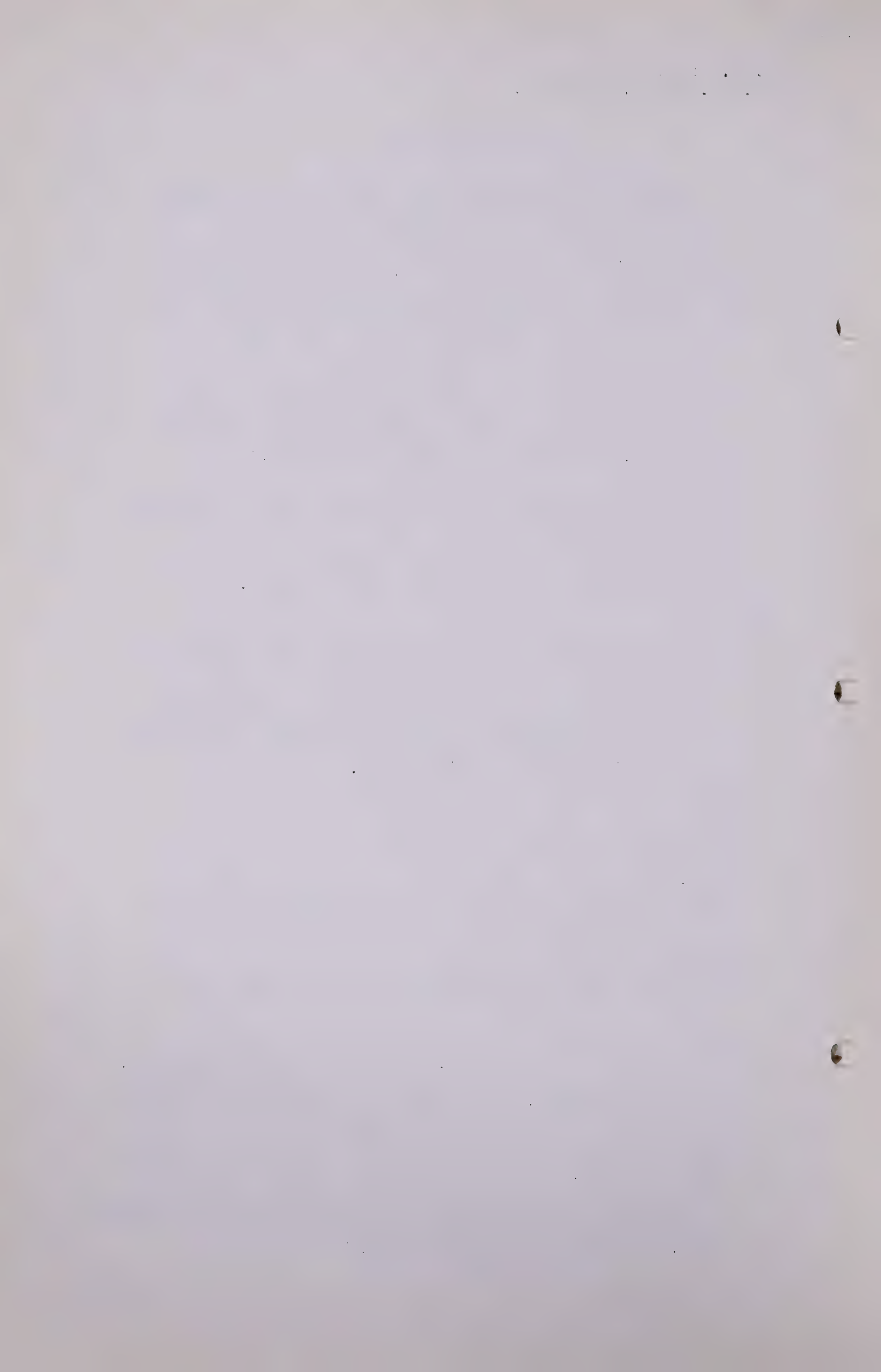
Q In other words, it is vertical and cuts right off?

A Yes.

Q Did you drill to the east, or if you drill to the east, I beg your pardon, if you drill to the east of it you will be off the structure entirely?

A That is right.

Q And if you drill to the west and you do not have a straight hole, you might go through as well?



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A Yes, it is possible.

Q It is possible. Now, Mr. Gray, Dr. Hetherington has kept track of your evidence, and he points out that on the east side you did indicate a dip or an inclination of roughly one-third of a mile from the crest in the Bonertz area?

A That is the west dip.

Q No east dip?

A No, there is no east dip in the field.

Q Oh, I am sorry?

A The Bonertz No. 1 is not the highest point in the structure, and you are still going updip to the east.

Q Yes, but I mean when you get to the crest, you then go down?

A No, not east.

Q Oh, I understood you to say that?

A No, that is a thing I want to emphasize, that there is no east dip. It is cut off by a fault along the north-east edge of the structure.

Q Well, I interpreted your remarks with regard to the one-third of a mile to mean that.

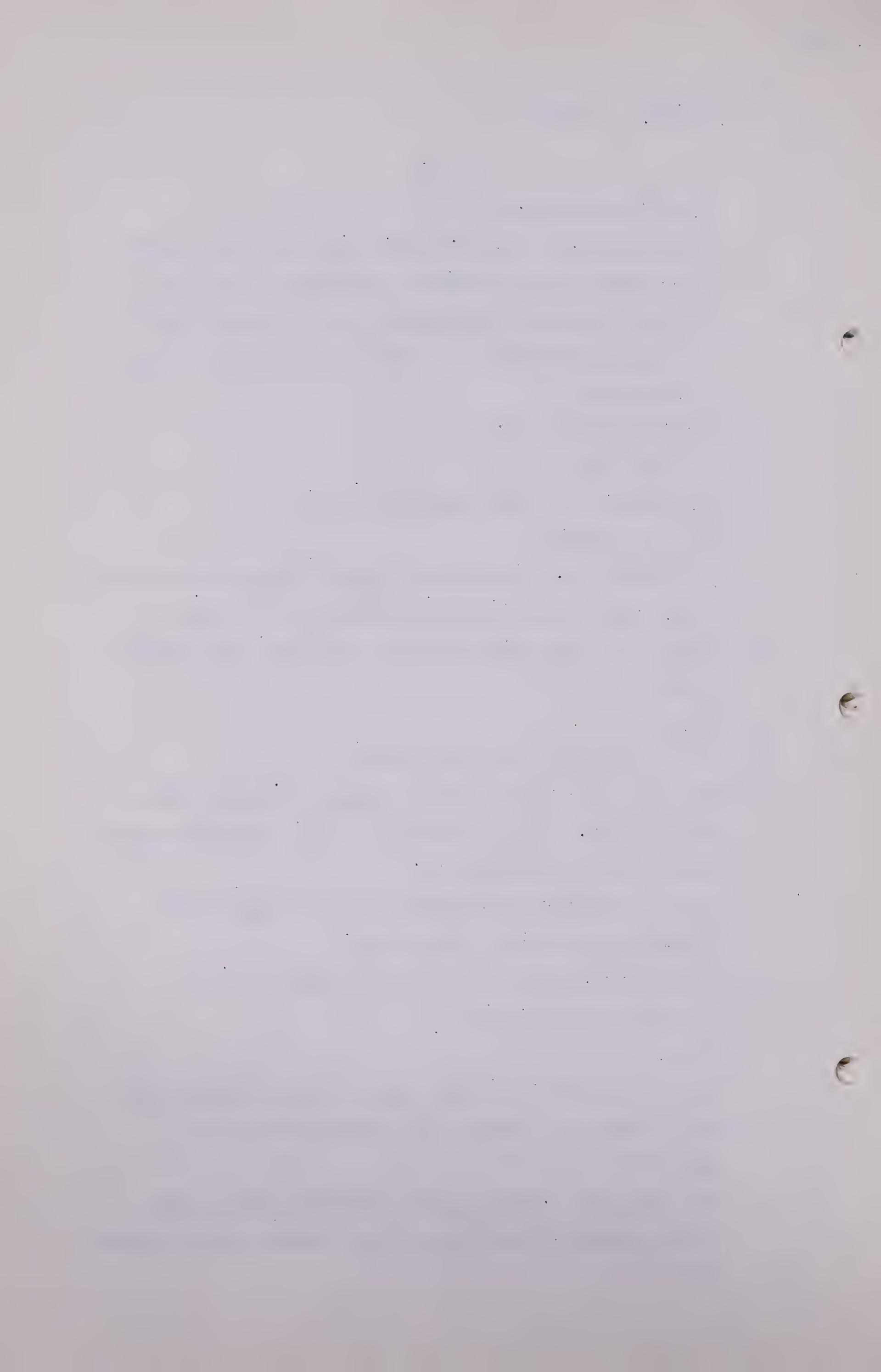
A I am sorry. All of that should be west dip.

Q It should be west dip?

A Yes.

Q So the one-third of a mile that you mentioned was the dip between the Bonertz well and the crest of the structure?

A That is right. Now, I gave - I may have misled you on the crest. I gave you the top closure on the contour line?



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Q Yes?

A The crest might be slightly further to the east, but the fault along the northeast edge is on the limits of the structure.

Q Then I was interested in the evidence of Mr. Galloway with regard to the area that he ascribes to the field, and at page 832, in Volume 9 of the Joint Hearing transcript, the question was asked by Mr. Smith, Mr. S. B. Smith, of Mr. Galloway,-

"Q I would like you to discuss and inform the Board the basic reasons which you had for arriving at your acreage of 11,680 acres?

A I had made available to me the data of the Canadian Gulf Oil Company, and I studied the seismic maps which had been made from the seismic data obtained in the area, and after a study of it I was convinced that there should be eliminated at each end of the structure or anomaly that portion of the area which showed a variation from the general central portion. In other words, at each end of the anomaly there was a change in character of the data which, based on my experience with a similar type of geophysical data, I feel that it indicates something of a different character has occurred, and I can think of a number of types of changes in structure which could be present there, and, under those circumstances, I believe that those or certain portions of the ends of that anomaly should be omitted in considering proven acreage on the anomaly."

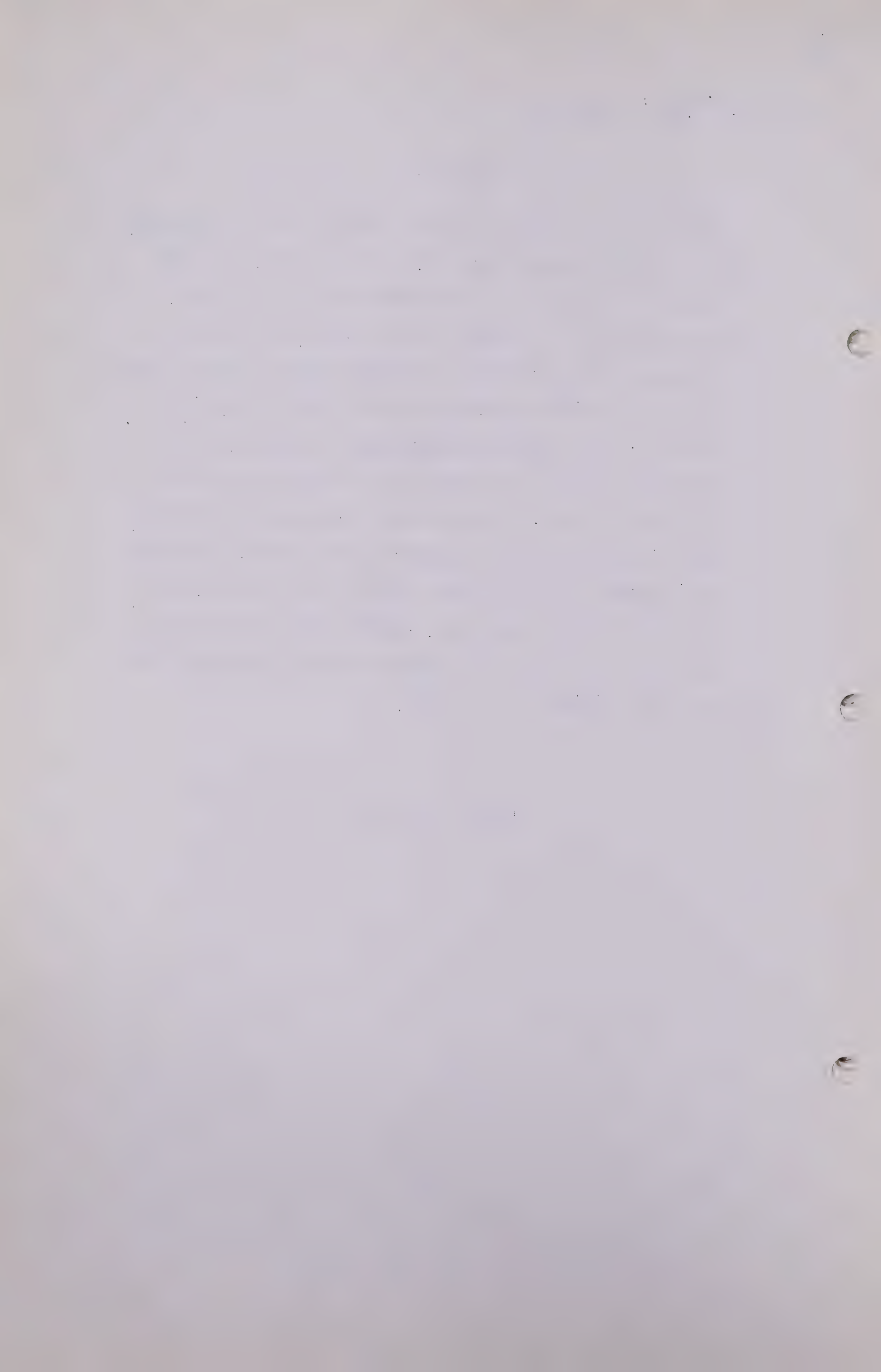
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And then on the basis of that I take it that he reduced his over-all acreage to 11,680 acres. Have you any comment to make on his interpretation of the data?

A In working out the limits of the pool, the matter was discussed with practically everyone that we thought would have any definite knowledge on that type of reservoir. In fact, some of the geologists made a careful study of Turner Valley to see whether it conformed somewhat to Pincher Creek. It was after discussing the matter with geophysicists and geologists, who should know how to interpret their own data, that we set these limits, the actual limits as shown, and the area was somewhat less than geologists and geophysicists thought was probably the limits of the field.

(Go to page 1378)



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Q Now, I would like to discuss this matter of fracturing. As I understand the results you obtained from the Bonertz well, that they are practically identical in result, indicate almost equal porosity and therefore equal fracturing in the general area of each one. Would you agree with me in that?

A I might explain, as far as the reservoir is concerned we do not believe that the fractures will contribute more than about 10 per cent to the reserve in the field. 90 per cent is in the inter-granular section and vugular.

Q Now, just continuing that, with regard to the matter of fracturing, have you any idea whether there is fracturing in each of the areas in which those three wells are?

A Very definitely there is fracturing, in fact, so extensive the cores come out of the core drills more or less like gravel. That is not throughout the section, in portions.

Q I was looking for Mr. Wilkins' comment on fracturing. We will go on to Mr. Leisemer's comment on this matter of fracturing and production. In volume 9 at page 909 Mr. Leisemer had this to say in answer to Mr. Nolan:

"A. I accepted all the data as presented by Canadian Gulf. I believe their acreage figure was 17,250.

Q. Yes, that is correct.

A. And bearing this in mind that we have only two wells that are actively productive, and one well in a tight part of the field, a tight part of the terrain, or a more unproductive part, I made a discount of 25%.

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"Q. Yes?

A. This represents what happened at various times or various places in Turner Valley, where there was taken somewhere between 35% and 40%, varying with the condensate."

I take it that he reduced, got a reduction because of this lack of permeability of fracturing in that Schrempp well, and he produces it at 12,938 acres.

A In regard to the lack of fracturing in the Schrempp well?

Q Yes?

A The Schremppwell penetrated the upper dense portion of the Madison Limestone and went into the upper porous. The upper porous is the one we feel has the greatest portion of the reserves. The upper dense is very small in proportion, probably not over 15 per cent. We definitely had fracturing in the upper porous zone, and probably did not have the instance of fracturing in the upper dense as we have had in the other wells. Now, that well is in the neighbourhood of 200 feet from the gas-water contact and would represent practically nil so far as reservoir is concerned because the entire upper dense section from there to the edge of the reservoir would be a very small fraction of any reserve estimates.

Q Well, is it for that reason you discussed this matter of upper dense and upper porous zone and the lower porous zone?

A The amount of reserves/^{that}could be attributed to the field from the point of, say, 200 feet from the gas-water contact is so minor it would not make any difference in



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the total over-all reserve.

Q Would it make any difference in the actual acreage that you use for your over-all?

A It might make a difference on the actual acreage. Even that would be quite minor.

Q I mean, in making your estimates your main element is acreage?

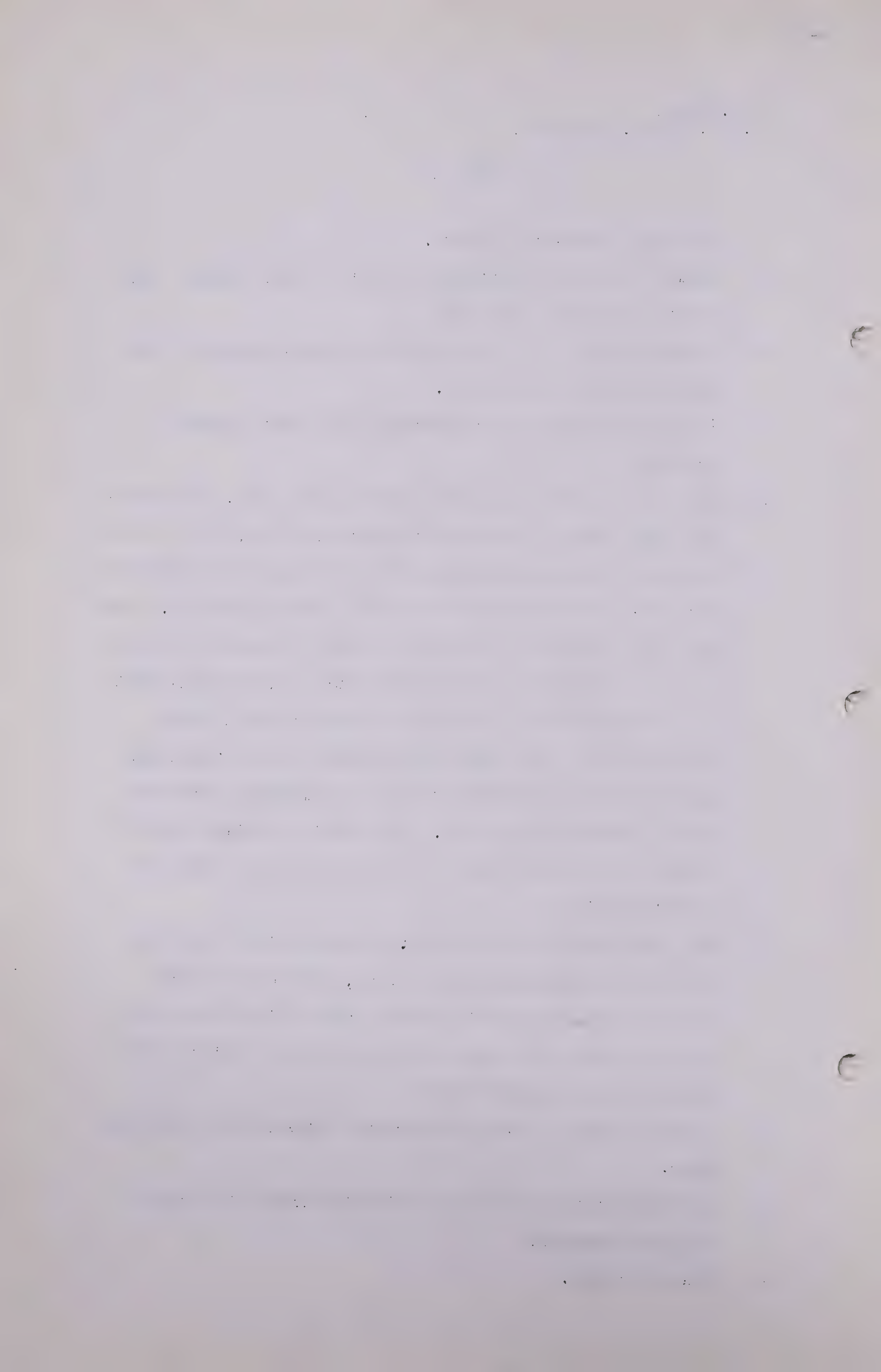
A There is one thing I would like to point out. This well has been commonly referred to as a dry hole, and I think it should be considered more as one temporarily abandoned for later consideration to make it into a producer. That well was drilled for the sole purpose of seeing if there was an oil band around that structure and we found that out. It was obvious it was not going to be a large producer and it was believed expedient to go ahead and shut the well in and wait for the development before we make a producer out of it. The fact we still have the casing in it would make us believe the well still has potentialities.

Q Now, what would you say about a well drilled half way between the Schrempp well and, say, the Bonertz well, would the deliverability be the same as the Bonertz or closer to the deliverability you would get out of this temporarily closed-in well?

A I would think it would compare very favourably with the Marr.

Q It would compare favourably with the Marr if it were half way between?

A That is right.



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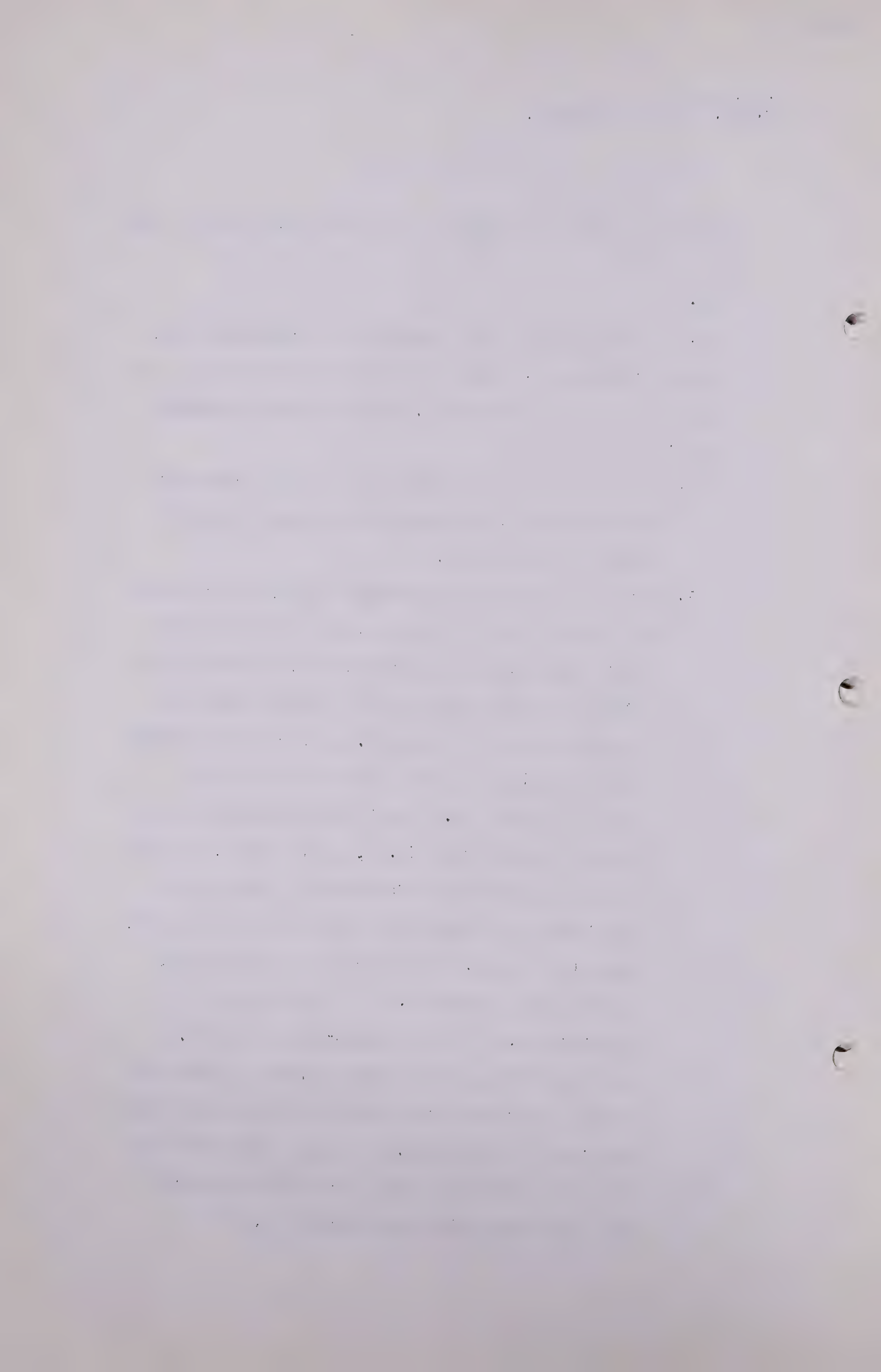
Q Of course, that is something the drill will have to tell us?

A Yes.

Q Now, to come back to this question of fracturing, Dr. Govier examined Mr. Wilkins at page 748 of volume 8 of the Joint Hearing transcript, and the first questions asked:

"Q. If you could just indicate to us the range of permeability and perhaps an average and that would be sufficient.

A. When we measure the permeabilities, as you know we can not get a plug through a fracture and therefore what we measured was the consolidated portion of the plug and it had relatively low permeabilities. I think they averaged probably 3 millidarcies for the productive section, which is quite low. The total millidarcy feet in the Pincher Creek No. 1, as I recall, of the measured permeability from small plugs was on the order of a magnitude of 180 millidarcy feet, some such figure. I will check to make sure. In the case of Marr No. 1 it measured 180 millidarcies, in the inter-granular system. In other words, on the small volume it was not taking into consideration flow tests which were conducted on that well. It was indicated that the total effective millidarcy feet in Marr No. 1 was some 1860 millidarcy feet.



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"Q. That figure was obtained by calculating backwards from the field tests?

A. Yes, sir. It is an application of the rate of flow equation.

Q. Does that indicate to you then that you are getting about 9 times as much permeability from the fractures as from the part of the reservoir rock which you were able to recover through cores?

A. Yes.

Q. Were the tests on Pincher Creek cores very similar to these?

A. Yes, they were on the same order of magnitude."

Now, how do you interpret that evidence, Mr. Gray? I had a different interpretation than yours and I was just wondering.

A In relation to the Schrempp No. 1, you mean?

Q Well, in regard to the question of permeability from the fractures as from the part of the reservoir rock that you can recover?

A Well, in the gas reservoir 3 millidarcies definitely would give you gas. We think that the fractures are more or less the channels through which the gas will be transmitted. I think 90 per cent of the gas is going to be in this type of section, only 10 per cent in the fractures.

Q That is the gas in place?

A That is right, gas recovery.

Q Maybe you and I are thinking of different things. In order to get the gas out, then, you have to have your

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fractures, isn't that right?

A Out fast. You can get it out.

Q Yes, over a period of time?

A Tight zones will contribute to the reservoir just as in the Schrempp No. 1 here. The porosity in there is probably around $1\frac{1}{2}\%$, 2%, possibly 3 or 4 millidarcies. It will contribute to the reservoir. It just means this well was not a high capacity well in the upper dense section of the reservoir.

Q But the rate will be slow at 3 millidarcies?

A So far as deliverability, yes.

Q So that your deliverability is going to depend to some extent on your fracturing in each area in which your well is drilled?

A That is right.

Q And we then come to this question that Mr. Leisemer raised of just how much this lower west side of the structure is going to contribute to your reserve, do we not? I mean, that is what he had in mind in making his deduction of 25% and coming down to 12,998 acres?

A I really do not know what he had in mind, but possibly that is it. I would like to point out that so far as that Schrempp No. 1, as I told you, it was in the upper dense member only and there are four different member producing formations, three of which were not present in the portion open in the Schrempp.

Q Well, I was just wondering.

A And all of those factors were taken into consideration in making our reserve estimates.

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Q Well, the only thing that I have to go on, Mr. Gray, is that my particular client only made their estimates based entirely on the data obtained from Gulf without any checking up, but evidently some of the other companies later on did have an opportunity of checking, and I have mentioned Mr. Galloway and Mr. Leisemer. Now, come to DeGolyer and MacNaughton and this will be in Exhibit 4. I see at page 4 of census division 2 the area estimated productive area, upper dense and upper porous zones 14,409 acres, estimated productive area middle hard crystalline lower porous zones 9,991 acres. Now, that is the part of the area. Then DeGolyer and MacNaughton go on to give a total area of 18,205 acres. Yes, 18,205. Would that division between proved, probable and possible be based on the findings in the Schrempp well? You can not answer, you do not know?

A I do not know.

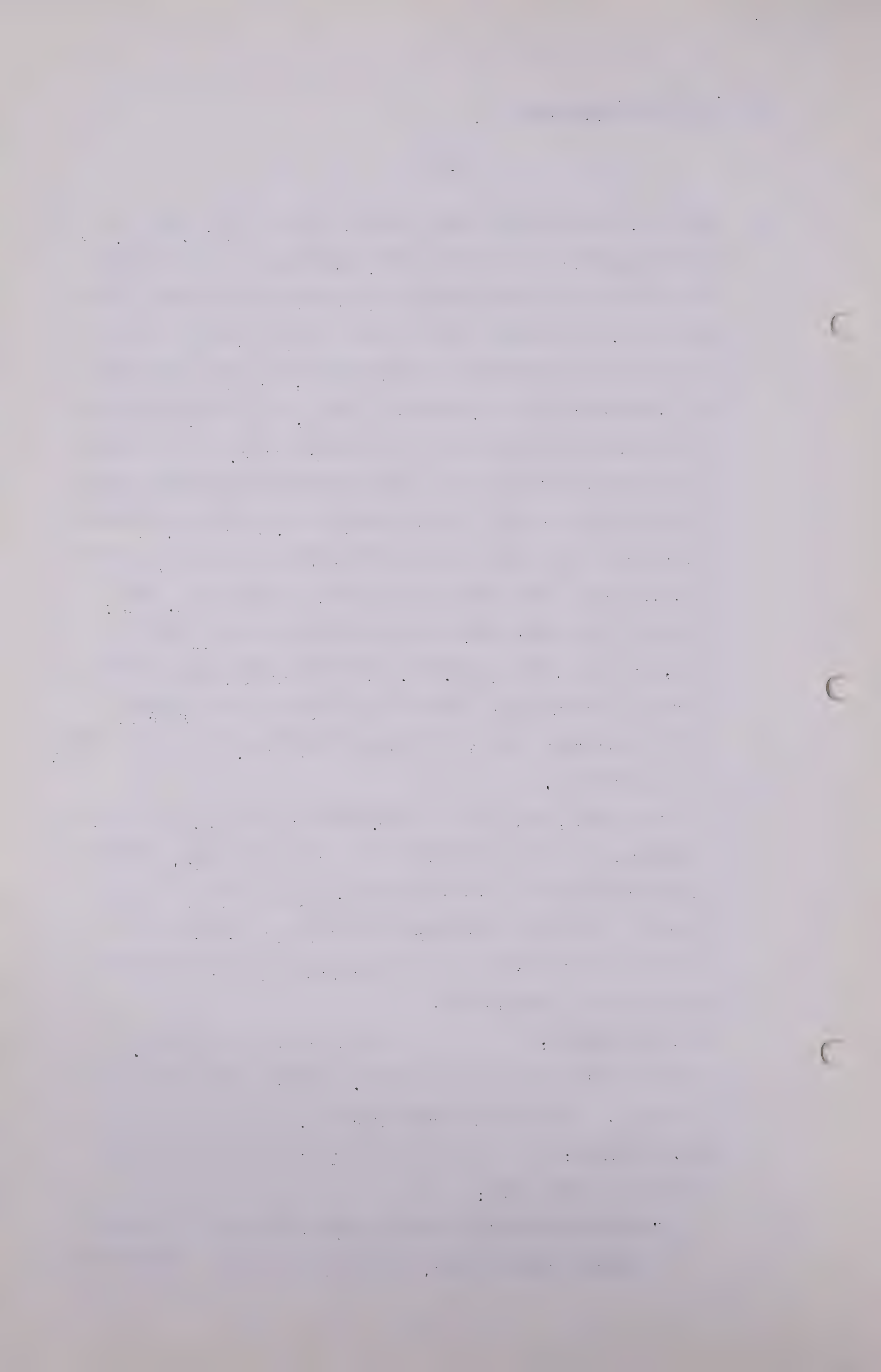
Q Then we come, Mr. Gray, to Mr. Davis's evidence day before yesterday in which he referred to this field and indicated - I am only quoting from memory and I hope I will be corrected -- that the fracturing of this structure he got would be on the crest of the structure and that you would not have your fracturing?

MR. C.E. SMITH: Here is the quotation.

You had better question on that. Right at the bottom of the page. It is even marked for you.

Q MR. McDONALD: It is in volume 14 of this Hearing at page 1224:

"The Mississippian shows a very low porosity through several hundred feet, porosities which, I understand



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"from the Gulf testimony, range from $2\frac{1}{2}$ to $3\frac{1}{2}$, more or less, per cent. Those are porosities, as I understand it, determined from certain core samples, and did not take into account structures in the rock. The gas in Pincher Creek is, to a greater or lesser extent, present in fractures. How much is in fractures, how much is in this rock of low porosity, I do not know; but it is the gas in the fractures that is surest to come to the surface. Now, what about the fractures? The three wells that are known to be substantially gas wells could have a large volume of production. However, if I understand it correctly, they did drill along the axis of the structure, pretty nearly in a straight line. Generally, according to my studies in geology, where you have a limestone or a dolomite that has been bowed into an anticlinal structure, it is common to find the fracturing more -- fracturing along the axis than along the flanks of that structure. "

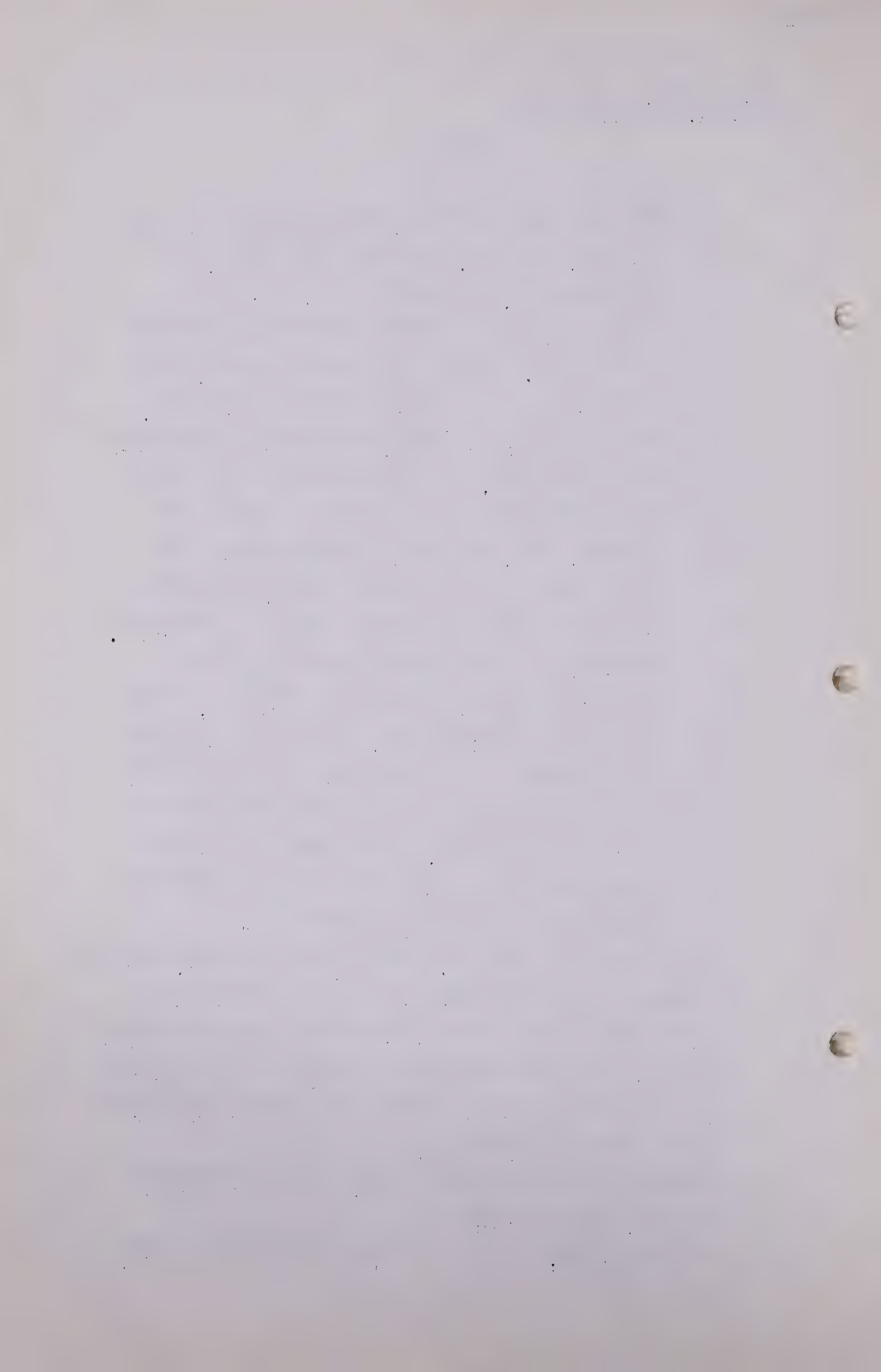
I interpret that that Mr. Davis and Mr. Leisemer, from the experience in the Schrempp well and the experience in Turner Valley, that their conclusion is that the productive acreage could and should be subject to a deduction from the actual acreage shown on the seismic map which your company is relying on.

A Did you want me to comment on Mr. Davis's statement?

Q Yes, Mr. Davis's first.

MR. S.B. SMITH:

That is not all he said.



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A I think to start out, that statement would indicate he did not know very much about Pincher Creek. Marr No. 1 was 500 and some odd feet lower structurally than the Bonertz. The Bonertz is some three or four hundred feet from the crest. Both of those wells had high capacities and high potential production. Both of them were fractured. In other words, the Marr No. 1 is probably 300 feet from the edge of the structure and we had fracturing down to that point, and Bonertz No. 1 within a few hundred feet of the top of the structure and we had fracturing. The main point I would like to take issue with would be that the majority of the gas is in the fractures. I would agree that the porosity would range from $2\frac{1}{2}\%$ to $3\frac{1}{2}\%$. We found it much higher than that. What we used in our calculations is $2\frac{1}{2}\%$ average porosity. So that I think he is entirely mistaken that those wells were drilled down the crest of the structure. I think he is entirely mistaken on where the majority of the gas reserves are located.

Q MR. McDONALD: Well, yes, you had already dealt with the matter of where the gas was in the structure or in the fractures.

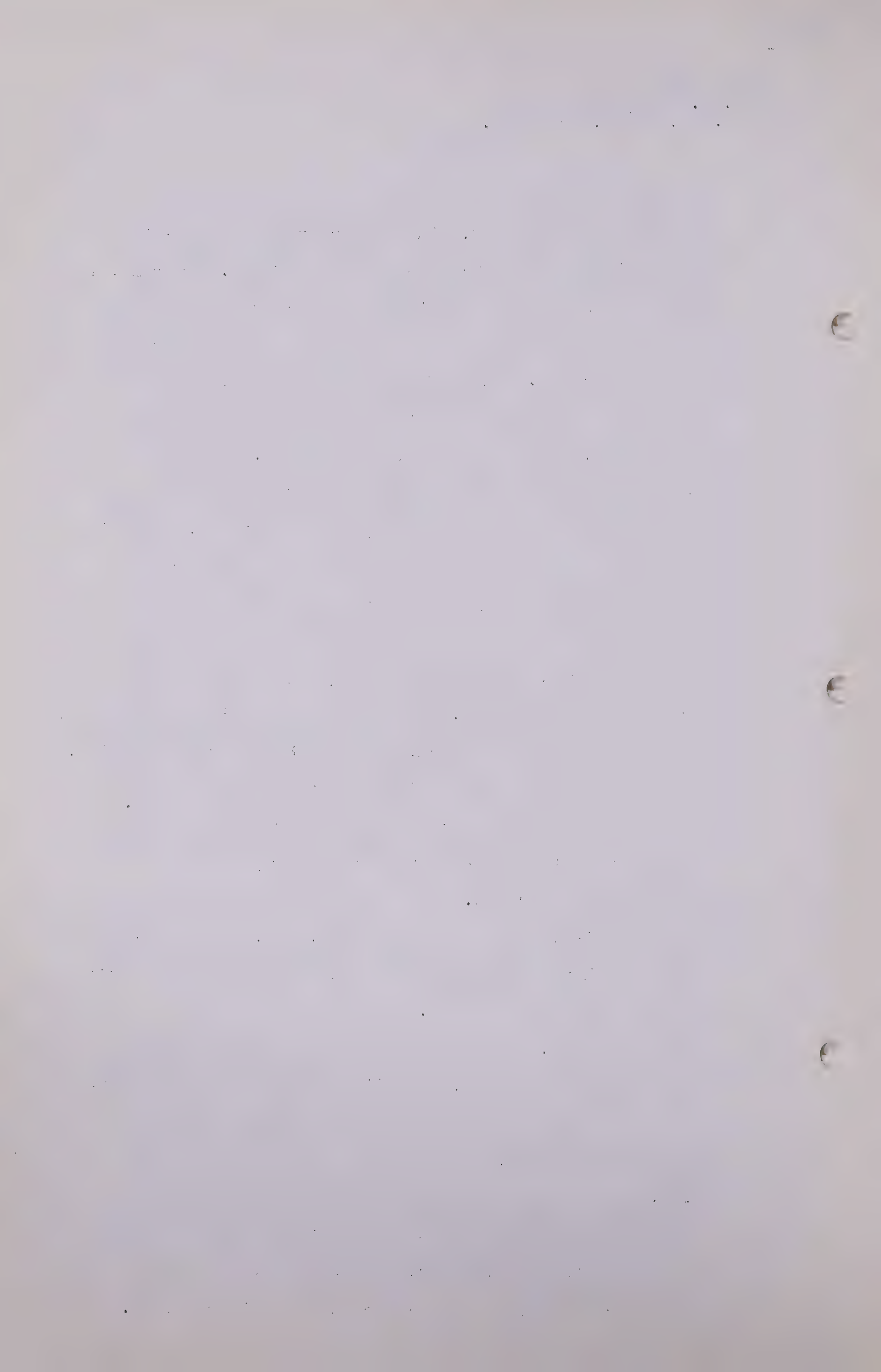
A That is right.

Q This question of deliverability is the second part Mr. Davis makes, is it not?

A Of deliverability?

Q Yes.

A Three wells right throughout the field north to south almost evenly distributed, I think, would lend quite a bit of confidence to the capacity of deliverability.



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Q In on the point of the structure, the relative high or low of the structure, for those particular wells?

A That is right.

Q And then with regard to the wells drilled to the east and to the west in order to have the same deliverability?

A The wells to the east would be nearer the crest of the structure, the wells to the west will be down dip, and in anticipation that the pool will probably be unitized, I mean whether there will be very many wells down the west portion of it, I question that.

Q Now, there is just one other point I would like to ask you and that is about this sole fault to the east. Is it also a west-dipping fault like the rest of the structure?

A I do not know that. My recollection is that it is a fault that dips towards the west.

Q As far as you know it dips towards the west?

A That is right.

Q Have you any idea of the inclination, is it comparable to the dip shown by the wells, or have you any idea?

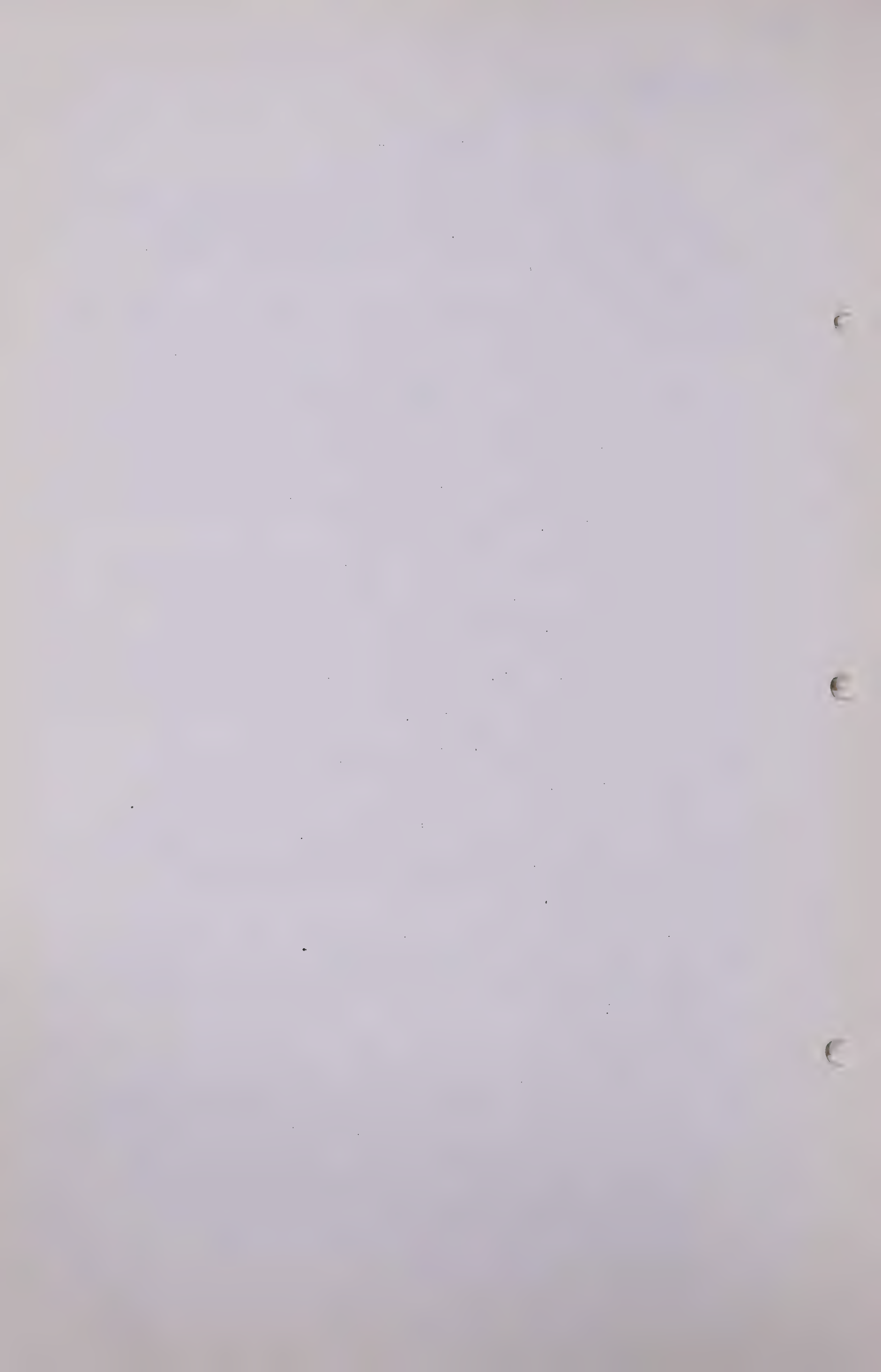
A I have no idea.

Q Now, if it was a straight dipping fault, would not that have the effect of cutting your productive horizons as it goes west?

A You mean if it was horizontal?

Q No, if it was horizontal the chamber would remain square and there would be no difference, but if it is dipping to the west, and my left is the west, it will cut your reservoir at the east portion of it.

A It might.



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Q It might?

A Yes.

Q And that would then cut the reservoir as estimated in your reserve picture?

A Well, the productive section is only about 450 to 500 feet thick, I think, and that would be a very minor consideration.

Q Well, Dr. Hetherington estimates, and you can deal with it now, I will give it to you, that if the east-west, if the fault, the east fault is dipping to the west at an angle of 30 degrees it would cut off about one-third of the productive reservoir as at Pincher Creek No. 1 well, do you understand what I mean?

A Yes.

Q I mean - -

A I do not know whether I would agree with it or not.

Q You do not know?

A No, I do not know anything about the dip of that fault.

Q Now, similarly, the same would apply throughout the entire field with regard to the dip?

A Certainly.

Q Depending whether it was 10 degrees or 30 degrees or 45 degrees?

A Yes.

Q And that can only be ascertained, Mr. Gray, by drilling, is that not right?

A And that would be very expensive to find out, to drill deep holes in there, and you would not want to.

Q Well, Mr. Gray, I think that is all that I have to ask you



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about that particular subject. In your exhibit you deal with, on page 1, the second paragraph, you deal with your measurements and you give the production, your total gross gas reserve to a depletion pressure of 100 pounds per square inch of 1.65 trillion cubic feet of high pressure separator gas. Now, translating that to raw gas in place, am I right that it is 1825 billion cubic feet?

A 1825?

Q Yes?

A Well, I do not know. We did not arrive at it quite in the same way as some of the other estimators. The high pressure separator gas volume was determined from what we call a model reservoir test in which we took reservoir fluid and tried to reproduce the conditions which will exist in the reservoir down to depletion.

Q Will, what would it be down to depletion instead of 100 p.s.i.?

A It would be a little more. That 1.8 sounds reasonable.

Q 1825. The reason I have come to that figure, it was given in the original list of statistics submitted by your company?

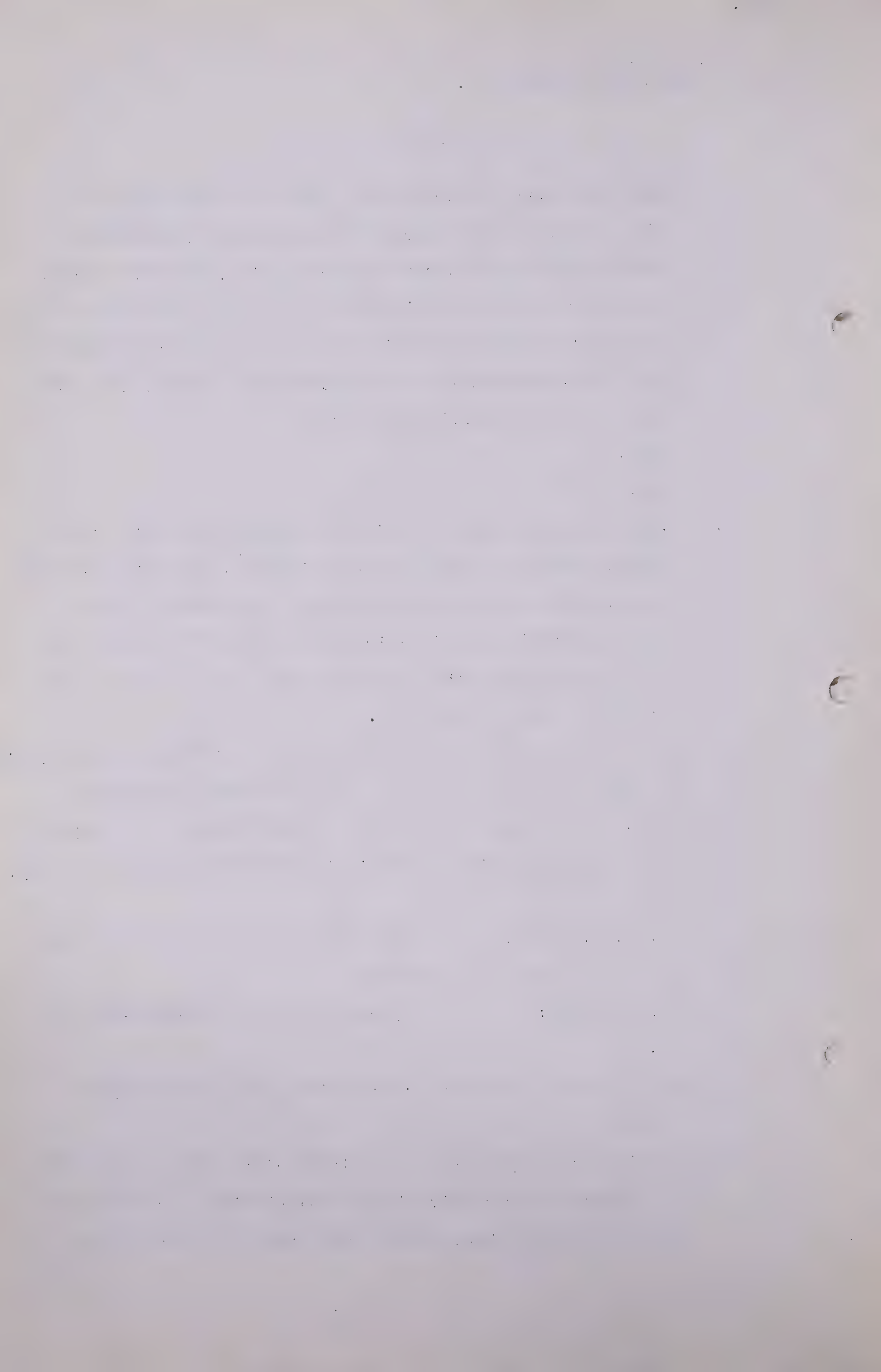
A Yes.

MR. C. E. SMITH: You should not have told him that before you asked the question.

MR. McDONALD: I wanted to know whether that is so.

Q Why is this a different calculation than you made previously?

A I think actually there was a little difference in the area we considered productive in the calculation. I think at the time we had that, or did that, that last year we had



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a little bit more than 18,000 productive acres.

Q Yes. And your judgment is now that the 1825 figure is fairly close?

A That is right.

Q Now, at 100 pounds to the square inch in those particular wells, my information is that the production would have to be about 500,000 cubic feet per day at 100 pounds. That it would be about that. Have you given any consideration to that?

A I do not know whether that figure is correct or not, but it would be low.

Q It would be low?

A Yes.

Q I think, using Mr. Davis' exhibit the other day, that it showed it was about there and the exhibit filed by Westcoast also would indicate that that was about the production at 100 pounds, at open flow, 500 Mcf per day at open flow. Just to identify your figure, Mr. Gray, you have a net marketable gas reserve of 1.32 trillion cubic feet, that is 80% of your 1.65 trillion?

A Yes.

Q Is that right?

A That is right, yes.

Q What was your reserve, have you a figure for your reserve at 400 pounds?

A It is not included. At the 400 pounds depletion pressure the raw high pressure separator gas would be 1.56 trillion, the marketable gas reserve 1.25 trillion.

Q Now, just dealing with the matter of shrinkage . . .



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A Yes, sir.

Q as I understand it, your experience is that there is 20% shrinkage, and you think that is adequate for calculations?

A Yes, I do. There is about 16% of acid gases that will be taken out in scrubbing, add 4% to the total, and that should be much more than adequate particularly during the early life of the reservoir, and there is another change, a source of heating that was not mentioned in the submission, in the process of making sulphur, the hydrogen sulphide was burned, and there is a very substantial amount of heat to be used in different parts of the plant for fuel.

Q The reason I asked the question, Mr. Gray, was to see if you had taken the experience of Jumping Pound with regard to the shrinkage factor?

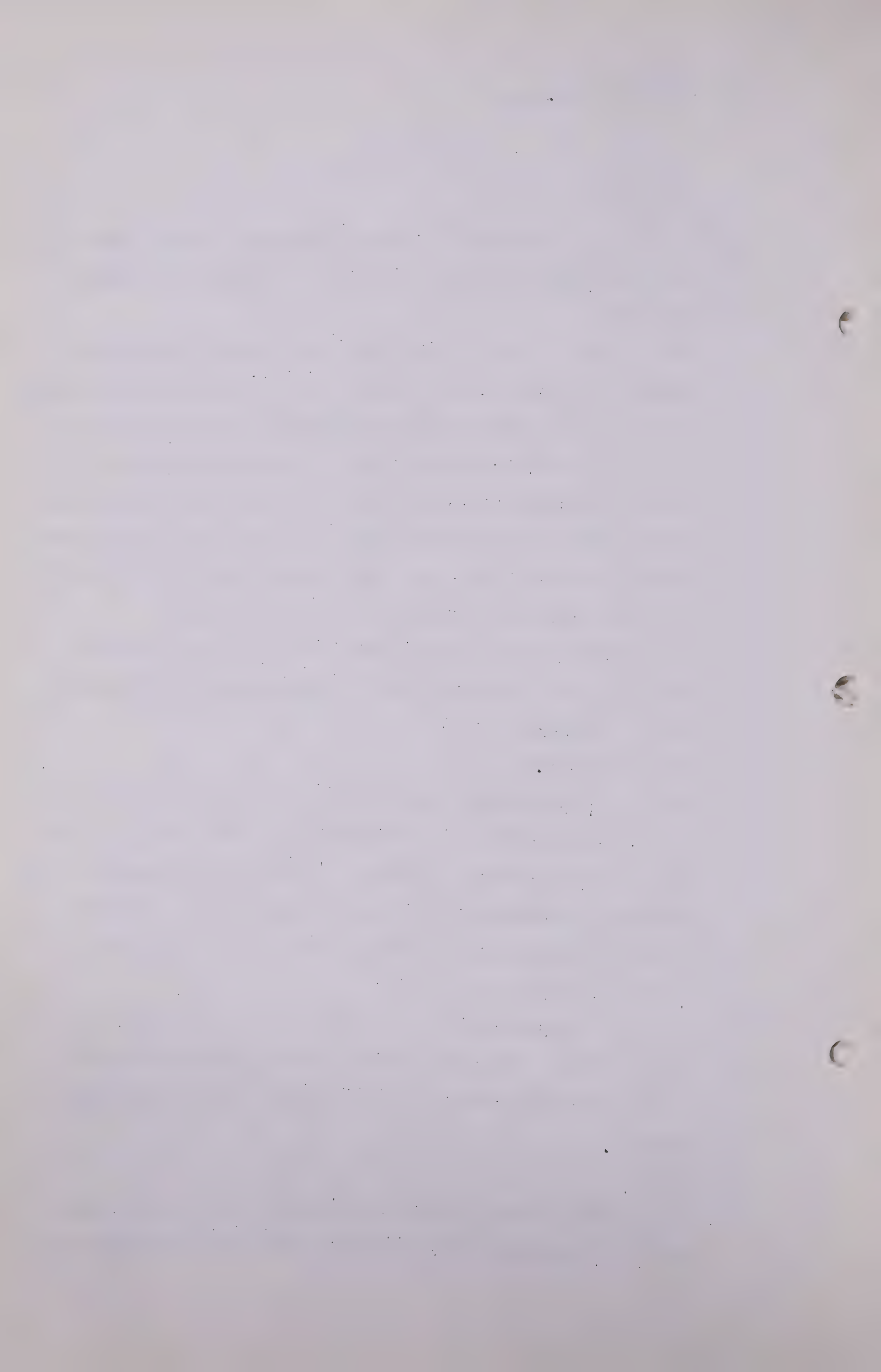
A No, I have not.

Q Well, as I understand from the monthly reports of the Board, they indicate that it is approximately 20%. There is less CO₂ and less hydrogen sulphide. In that case I was wondering whether the difference between the CO₂ and the hydrogen sulphide should not be added to your 20% to arrive at a figure closer to 25 or more?

A I am not familiar with their plant or the efficiency of their plant. There is a great deal of difference in the amount of hydrocarbons that are carried through the acid gases.

Q Yes?

A And if they have a high hydrocarbon content in their acid gases, I am sure they will have a great deal of difficulty



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in making sulphur, if they want to extract sulphur.

Q Now, then, we come to your conclusions as to deliverability on page 3, and you say there "To produce during routine operations at rates of 20 million cubic feet per day or more." Did you have in mind 20 million cubic feet per day average or was that peak load?

A I think that would be in the early stages of the production, but, on the other hand, we have no information that would indicate that there should be any limits placed on wells in a pool such as Pincher Creek, and in view of the present steel situation it certainly would be economic waste to drill more wells than are needed.

Q Yes. Well, you would take the 20 million cubic feet a day average then, to be the average then?

A I would say the average capable of being produced. It could very easily produce 20 million feet or more.

Q I have exhibit 80 in the Westcoast case, which I think is the same graph, the Pincher Creek field, absolute open flow potential as indicated by back pressure test, and I think this was prepared as of January 5, 1950 by RBW. Will you take a look at that, Mr. Gray? I think it is contained in the other report.

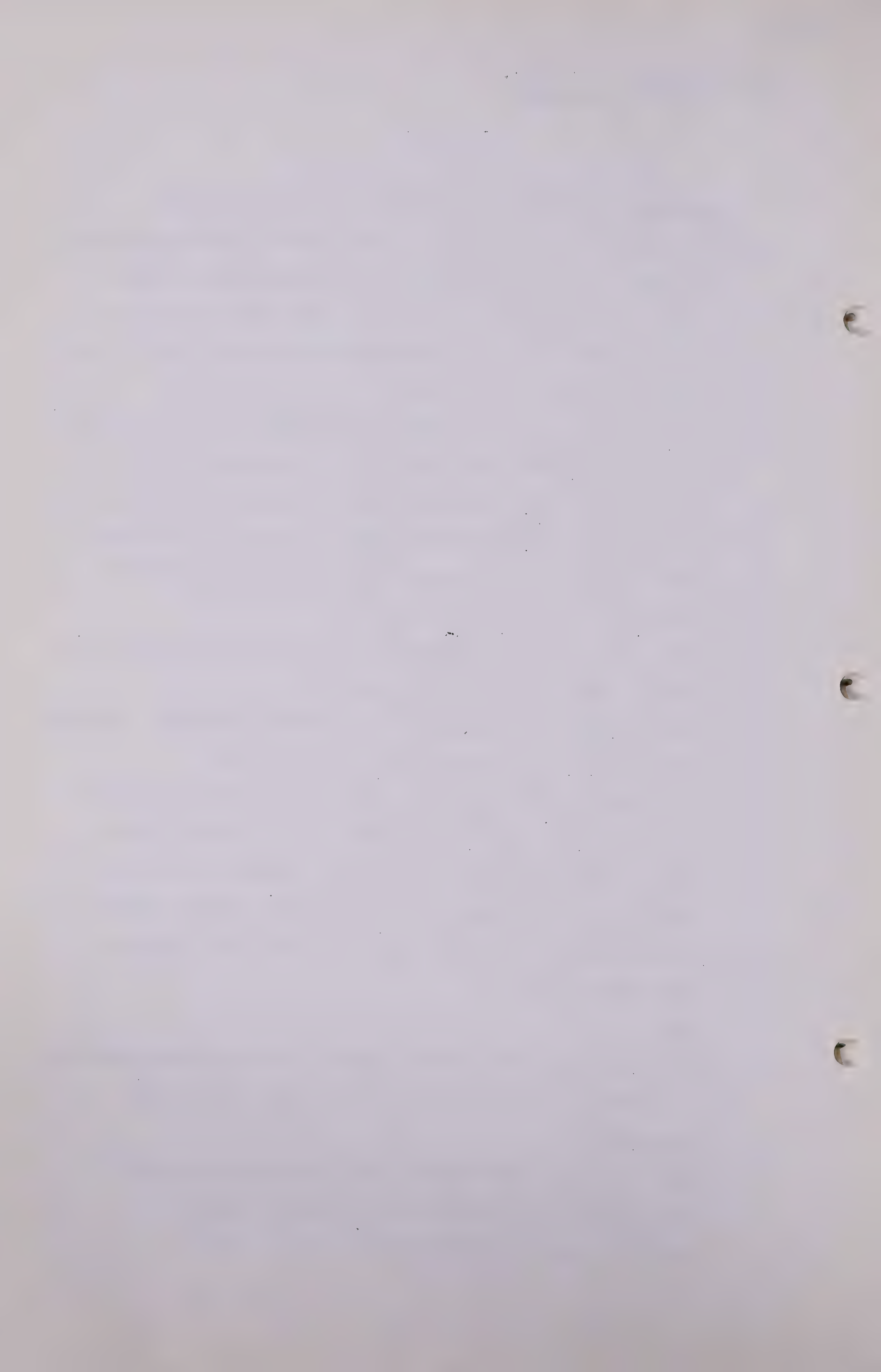
A Yes.

Q This graph contains present material that you have available as to indicating the deliverability from the fields?

A This graph?

Q Yes. I mean, I understand from your submission that you have not made any other tests of the new wells?

A We have a test on Bonertz No. 1.



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Q Well, you have just indicated that on page 1 of your exhibit?

A Yes.

Q Well, now, will you just apply the information you have to Bonertz 1 as indicated on page 1 to the exhibit, and tell me with reference to the open flow line, the open flow that you indicate that it came out at? Now, I did not put that in engineering terms, but I understand that you can take your calculation and pick out your point on this graph from information that you have set out here. Can you do that?

A I think that to use our information, the open flow on that well would be in the neighbourhood of 80 million feet.

Q On doing it you find that at 30 million open flow it comes identical to that on line 4 of this exhibit?

A Yes.

DR. GOVIER: Did you say 30 million?

MR. McDONALD: 30 million open flow.

A No, 80 million open flow.

MR. C. E. SMITH: 80 million.

MR. McDONALD: I am sorry, Mr. Chairman, it was 80.

MR. C. E. SMITH: You have cut it down by over 100%.

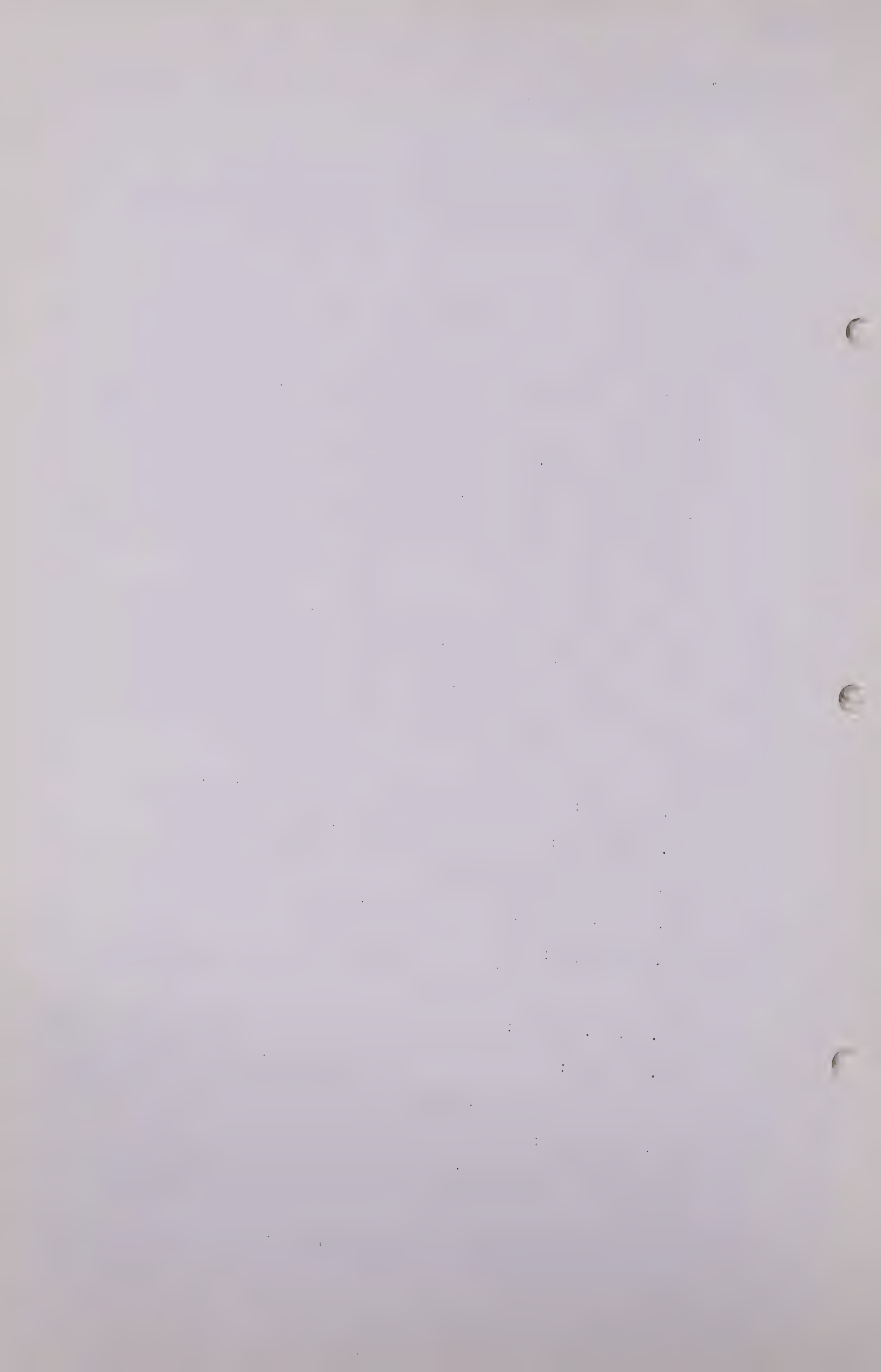
DR. GOVIER: Mr. McDonald, have you got a spare copy I can look at, please?

MR. McDONALD: Yes.

A That would be assuming it at the same slope as curve 4.

Q Yes.

A And if you put it on the same slope as curve 1, of course,



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it would be substantially greater, maybe 150 million.

Q The point I have is that the information set out, which is put up on the same slope, it is the same as on line 4?

A It should be right on that line.

Q It should be right on that line?

A Yes.

Q So that it indicates that the well is relatively the same well as far as deliverability is concerned as Walter Marr No. 1?

A That is right.

Q Am I right in thinking that it would indicate the same porosity, the same productivity, the same type of structure?

A I think so.

Q And that as far as the new well is concerned, that this information does not add to the estimated estimates of the productivity of the field?

A No, I think it merely confirms.

Q Now, in arriving at your 20 million cubic feet per day, did you make any calculations along the lines of these deliverability calculations that have been made by the other parties, the other applicants here?

A Do you mean the time?

Q No, no, no, I mean, did you work out the "n" slope?

A No, we did not work that out. We have it, I understand from Mr. Wilkins.

Q What slope did you use?

A I believe that would be a question of Mr. Wilkins answering, a question that Mr. Wilkins could answer much better than I could. I did not make the calculation.

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Q Well, he is not going to be on the stand.

MR. FENERTY: I am going to put Mr. Wilkins on
the stand to answer some questions.

MR. McDONALD: You will?

MR. FENERTY: Yes.

MR. McDONALD: Well, I will ask him.

A I do not know that I understand what you are speaking of.
We have made a number of calculations of capacity with time.
Is that what you have in mind?

Q Yes, I would like also to know the basis of the estimates.

A These estimates are based on the reservoir pressure, and
certain estimated volumes produced and the reservoir pressure
declines with time in those estimates. That is estimated
produced volume. This is a purely hypothetical case, and
we have used just a matter of drilling 4 wells a year. And
by doing that we will have daily capacities of net pipe line
gas ranging from 128 million cubic feet per day the first year
with 7 wells up to 269 million cubic feet per day in the 5th
year. Now, that is assuming that the average daily load
ranged from 101 million in the first year up to 200 million
in the latter year.

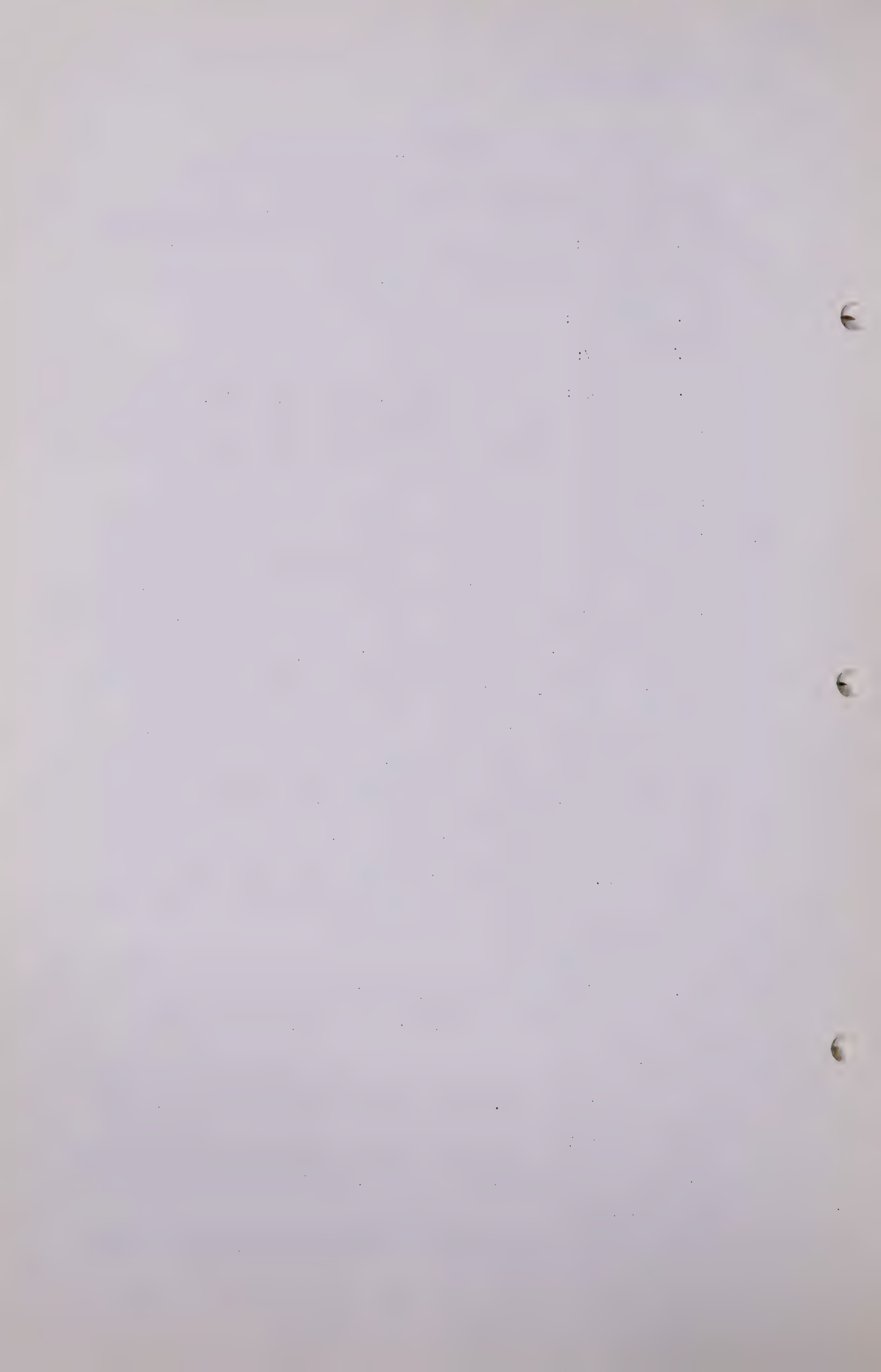
Q Now, in arriving at that tabulation, Mr. Gray, what consider-
ation did you give to proration or restricted flow?

A There was none.

Q That is just operating the wells in order to produce that
amount of gas?

A Oh, that was based on 20 million, a little over 20 million
rate per well.

Q That is your peak production then would be just something



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over 20 million?

A Capacity produced?

Q No, what peak did you use so that it would be 20 million feet a day average?

A It was based on 80 million cubic feet well initial and a reduction in the capacity due to reduction in bottom hole pressure.

Q Yes?

A In other words, they could produce there 20 million cubic feet at least past this period of 5 years, I believe it was.

Q Do I understand you correctly that this estimate is made without regard to any regulations that are presently or may be put into effect by the Conservation Board?

A That is right.

Q Yes.

A Now that is not open flow capacity of the wells, that was merely that they could produce at this rate for that period of time.

Q Now, I think that you referred to a number of wells, as I understand it. How many wells did you have in mind to produce your 100 million cubic feet per day, the 100 million cubic feet per day that you referred to in your first year?

A That could be done easily with 7 wells, possibly less.

Q And then you get up to 250 million feet, and how many did you have in mind for that?

A Oh, that high would probably take 24 wells.

Q That was, as I understood you, that was in the 5th year?

A That is so, assuming around 20 million per well, which is low, I think.

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Q And that would be 24 wells in your estimated area of 17,250 acres?

A Yes.

Q Now, I think you told us how long it took to drill a well?

A 10 months.

Q And I assume the drilling is expensive?

A It is quite expensive.

Q Would you care to make an estimate at all of the number of \$100,000.00?

A Very close to one million dollars, when you take in all the producing equipment.

Q As I understood you formerly, you would have four rigs working?

A On that particular program?

Q On that particular program?

A Yes, that is not necessarily what we propose to do at all.

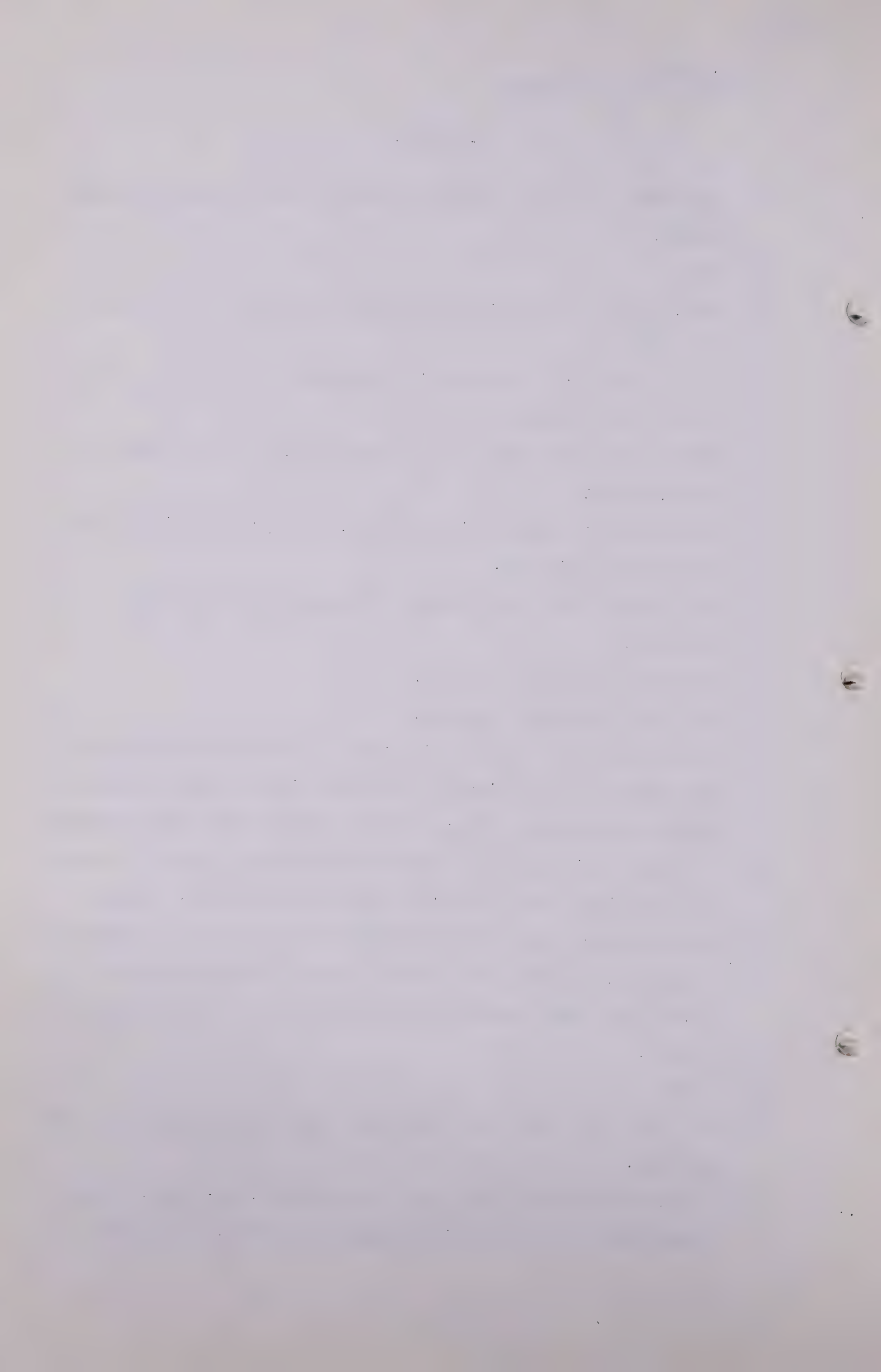
Q And would you anticipate that those rigs and that equipment would be available if you were to proceed with that program?

A I do not think we would have any trouble at all on the rigs. In the first place, I believe we would get them. In the second place, even although they could not get that number of big rigs, we could drill down to in the neighbourhood of 8,000 feet with smaller rigs and then move on the large rigs later.

Q Yes?

A So that two large rigs would take care of it to drill 4 wells a year.

Q Now, referring to page 4 of your exhibit, Mr. Gray, in the paragraph at the top of the page, you state, I am sorry, it



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is the paragraph at the bottom of the page,

"Canadian Gulf, therefore, had to assure itself that
an adequate market exists, and this it has done."

Just what market did you investigate that you have reference
to there?

A The one that we investigated was the Pacific Northwest
market, and it might be explained that there was very good
reason to do that, for the reason that that particular area
has not yet been served with natural gas, and the potentiality
of the market was really not clearly known, and the rate of
growth of the load was not clearly known. Of course, there
had been considerable information submitted to the Board here,
and our investigation indicated that the market of the Pacific
Northwest was at least as high, and possibly higher than
that submitted.

Q And referring to the Pacific Northwest, you are referring to
Portland and North to Vancouver, B.C., on the coast?

A That is correct.

Q And the general Spokane area east of the Cascade Mountains?

A That is right.

Q Well, with reference to your figures in that paragraph,
this 150 million cubic feet of day, is that the average load
that you would anticipate?

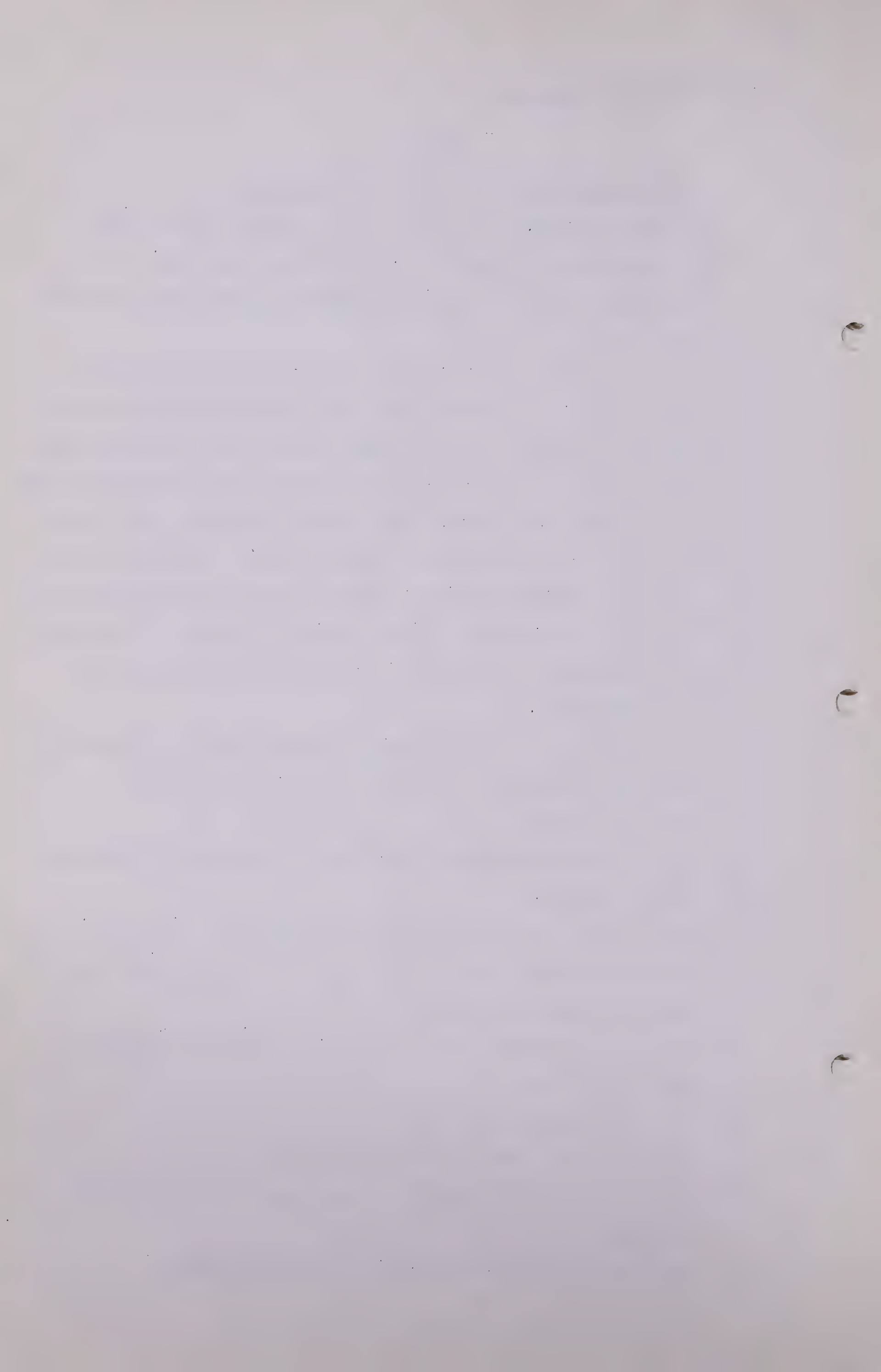
A Yes. It might go as high as 150. I think we could count
on 100 million.

Q 150 then would be the peak?

A Yes, that is right in the neighbourhood.

Q And the 250 million cubic feet per day, is that average
or peak?

A No, the 250 million would be average throughput.



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Q Average throughput?

A Yes, and that would probably be available, that market would be available in a very short time.

Q Now, you refer on page 5 to the matter of financing. You said:-

"Also in order to be financed the project will have to be assured of a supply which will approximate at least the initial market requirements."

Do I take you to mean there that with the initial market requirement being made available that the pipe line could be financed and construction commenced, provided all permits required are given?

A That is correct.

Q Yes. So that you feel that the initial requirement is sufficient for financing and commencing construction?

A That is right.

Q Now, then, your next sentence goes on to say,

"Anyone who has made arrangements for the purchase . . ."

MR. C. E. SMITH: ". . .who will have made . . ."

MR. McDONALD: Yes, I am sorry.

"Anyone who will have made arrangements for the purchase of Pincher Creek gas can give such assurance."

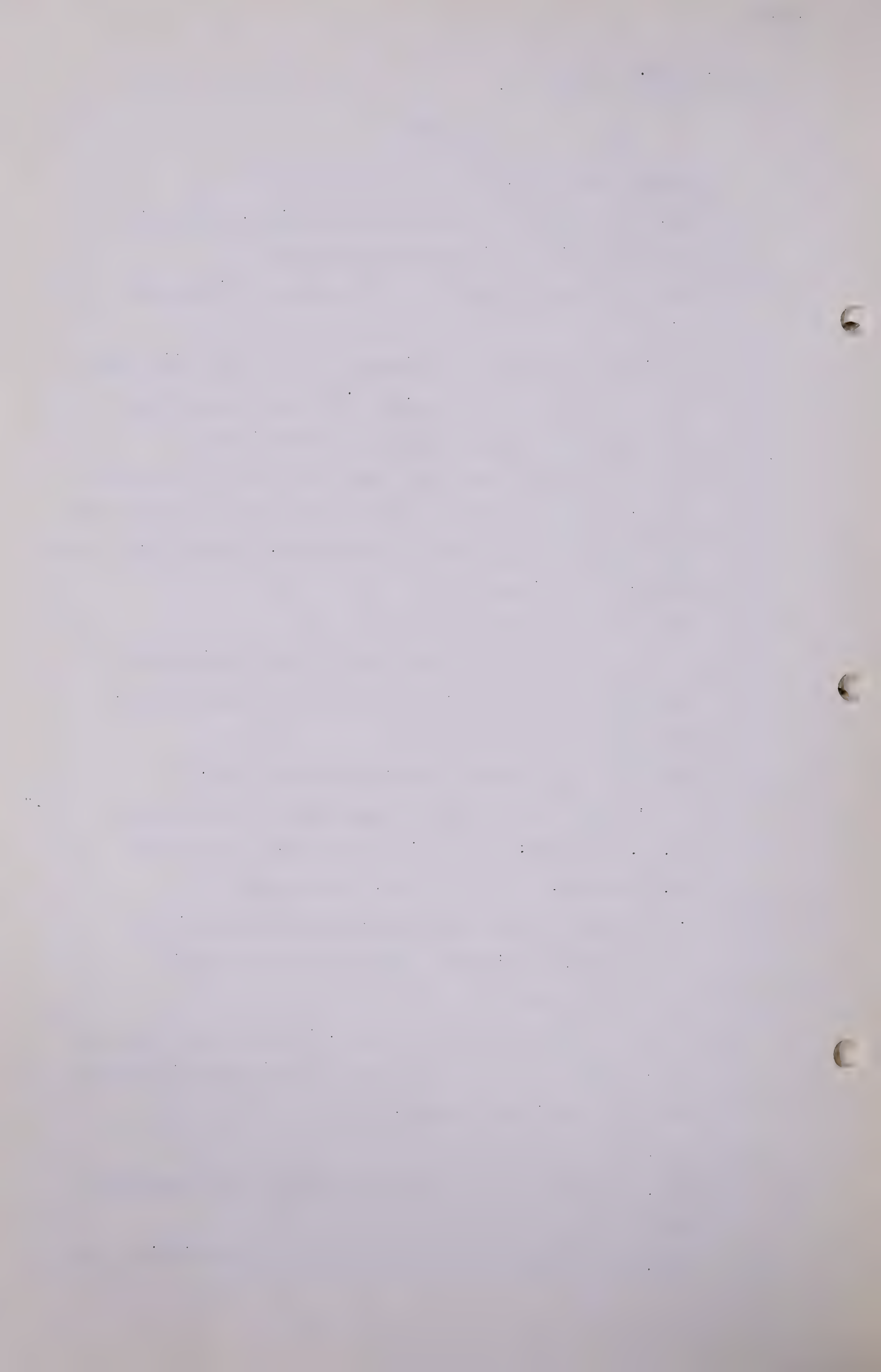
Do I take it from that, Mr. Gray, that you feel that the Pincher Creek field can provide the initial requirements for this particular market?

A Yes, it could.

Q And, therefore, it could be financed and proceeded with?

A Yes.

Q Now, what about the increased market of 250 million cubic



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feet a day, do you think or do you feel that Pincher Creek could also supply that market?

A I question whether it would take care of all of it, or whether it could take care of all of it. When you are on at too high a rate it costs a great deal of money to drill additional wells and build plants to take care of it. I question whether the field should be produced at such a high rate.

Q By suggesting that your company has found a market for gas and is prepared to proceed to develop the Pincher Creek field in order to serve it, you imply that your company is not concerned with the requirements of the people of Alberta, as outlined by Mr. Davis yesterday, and the Board in its Interim Report?

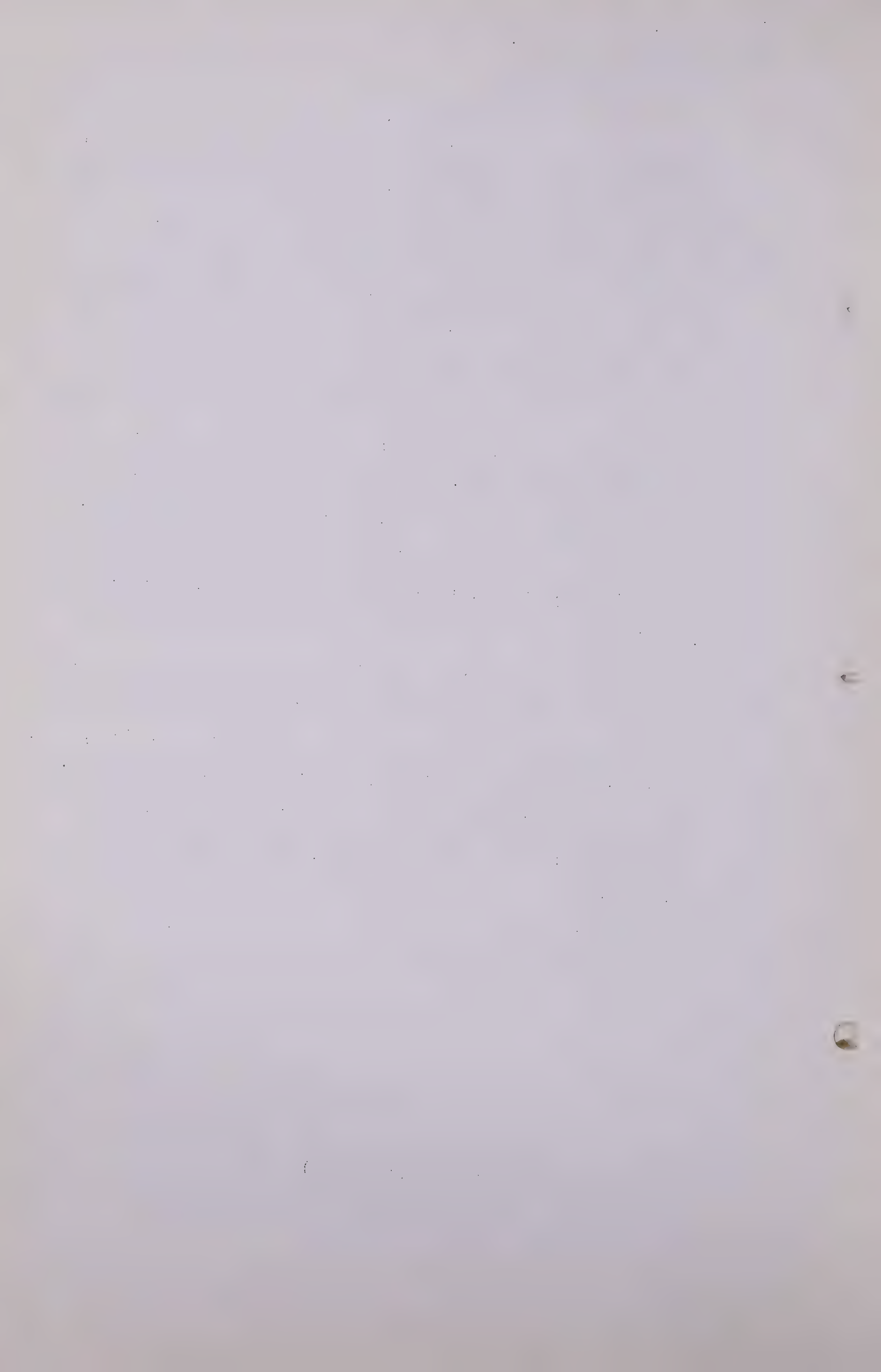
A This assumes that export is permitted, and that permits are obtained.

Q Yes. I might have some further questions from Mr. Gray, sir, after Mr. Wilkins is finished, or if I have a few minutes' adjournment I might make up my mind with regard to them.

THE CHAIRMAN: Very well, we will adjourn for a few minutes.

(Hearing assumed after a short adjournment.)

(Go to page 1401.)



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Q Mr. Gray, you were reading a moment ago from your summary of deliverability as calculated by the company. Could you tell me the deliverability that you would have in, say, the 5th year? I mean, what would be your maximum open flow, or do you have that?

A I haven't got that on that calculation. Incidentally, Mr. Wilkins made those calculations and I am sure he can give you that information.

Q Now, then, so that we can summarize, I have tried to summarize what you have said. I take it at 150 million Mcf. per day five years would average out about 55 billion cubic foot per year, would be the production from the field?

A Sounds about right.

Q Yes. I calculate that total 275 billion feet production in the first 5-year period?

A Almost 55 billion a year.

Q Yes, and gives a total of 275 billion for the 5 years. For the next 5-year period, say you operated at 200 million feet per day, that would be approximately 75 billion cubic feet per year?

A 73.

Q I took 75 and it came out at 375 billion for the 5-year period. That would give you a total of 650 billion for the 10 years?

A That is about right, yes.

Q And then say that you continued at the same rate for the next 5 years, that would give you a total of 1 trillion 25 billion in the 15-year period, and a total of 1400

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billion in the 20-year period?

A That would be very close.

Q And as I understand it, at 400 pounds pressure you estimate the reserves at something around 1200 billion?

A No, this is produced gas we are talking about.

Q Did I say pressure?

A It would be 1.56 trillion.

Q 1.56 trillion. Yes. At the end of the 20th year your estimate is 1.56 trillion.

A I think I stated that in that calculation it was marketable gas, 128 and the 200. Now, it is not our proposal that we produce it. We tried to illustrate we could easily take care of that volume if it was necessary. That has nothing to do with the length of time that we could handle that volume.

Q Didn't I understand you to say that over the 20 years you were going to make available this 1400 billion cubic feet?

A No, not at all. We have mentioned in our exhibit we take between 165 and 200 of produced gas per day.

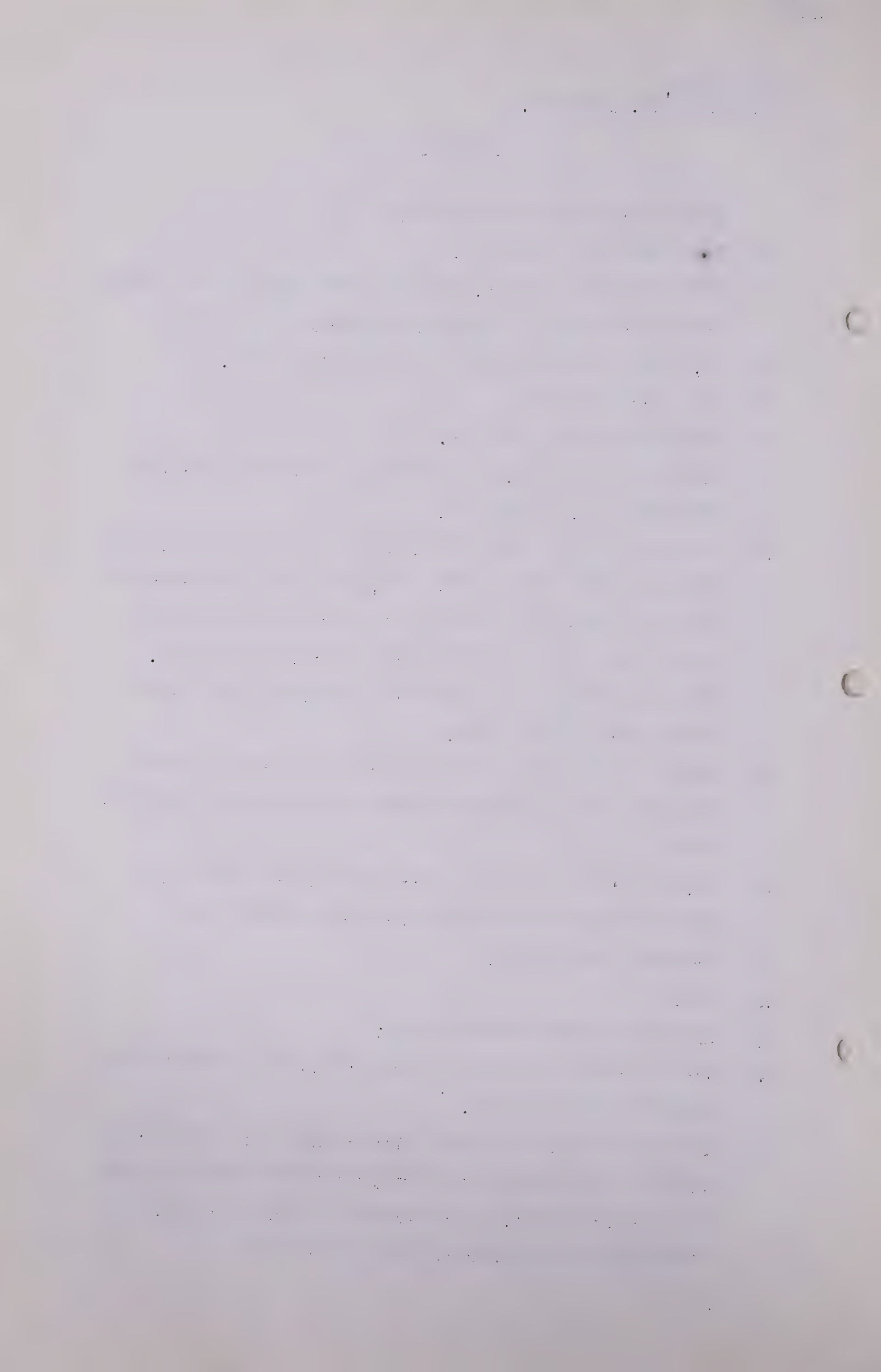
Q Produced gas per day?

A Yes.

Q And that is not marketable gas?

A That is right. It would range from 132 to about 160 of marketable gas per day.

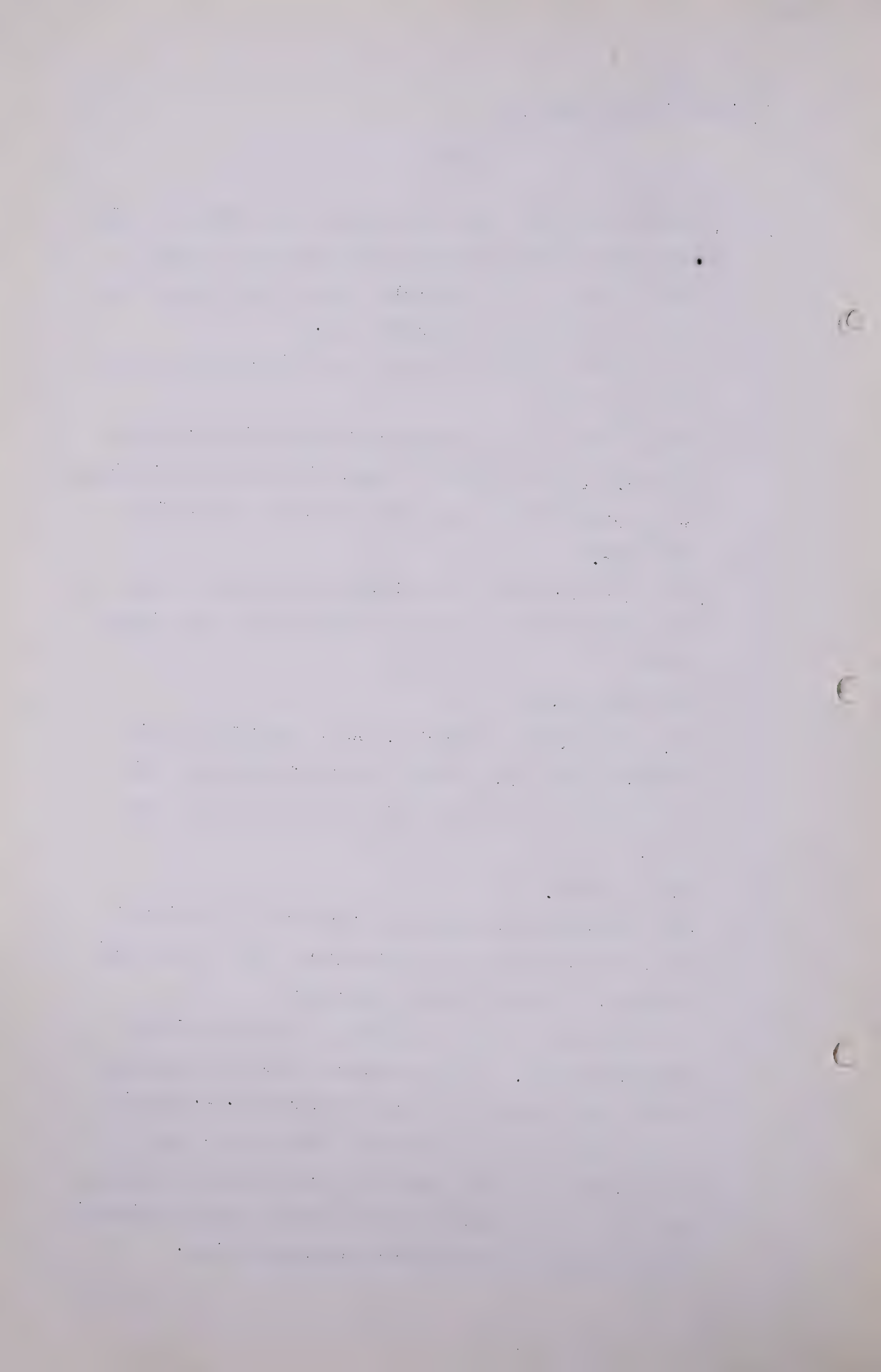
Q In other words, your peak deliverability on the average, when the field is at its most productive rate supplying the largest market, your average is going to be 165 million cubic feet per day marketable gas?



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- 1403 -

- A We are proposing this field should have production somewhere between 165 and 200 million cubic feet a day in order to make it an economical operation in view of the large investment in wells and plants.
- Q And over what period of time do you anticipate to take that production?
- A 165 million? It can produce at that rate in excess of 20 years. At 200 million I believe it could produce that for a period of 17 years with a slightly reduced rate after that.
- Q And at what pressure or is Mr. Wilkins going to tell us what pressure the field will be at the 20th year and so forth?
- A I believe he can.
- Q Now, then, just to summarize. As I understand your evidence, Mr. Gray, you have no information as to the inclination of the sole fault on the east side of the field?
- A That is right.
- Q And accordingly any estimate of reserves is subject to the fact that that sole fault may cut into and cut off a portion of the estimated reservoir?
- A I do not know that you could say it would be of any material amount. If that sloped at any great angle we should have touched it in this Bonertz No. 1. There is one correction I would like to make here. In calculating our 17,250 acres the calculation was carried only to the 8100 contour rather than the gas-oil contact which has been established at about 8200 feet.



F. L. Gray,
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Q MR. FENERTY: Gas-water?

A Gas-water contact, yes. So the area of the field has actually been discounted from the 8100 contour west.

Q MR. McDONALD: In other words, you have used a discount in making your estimate?

A Yes.

Q Now, what discount did you use, having relation to the sole fault?

A None.

Q And as I take it, your average porosity is taken over the whole acreage at 2.6 per cent or 2.9 per cent?

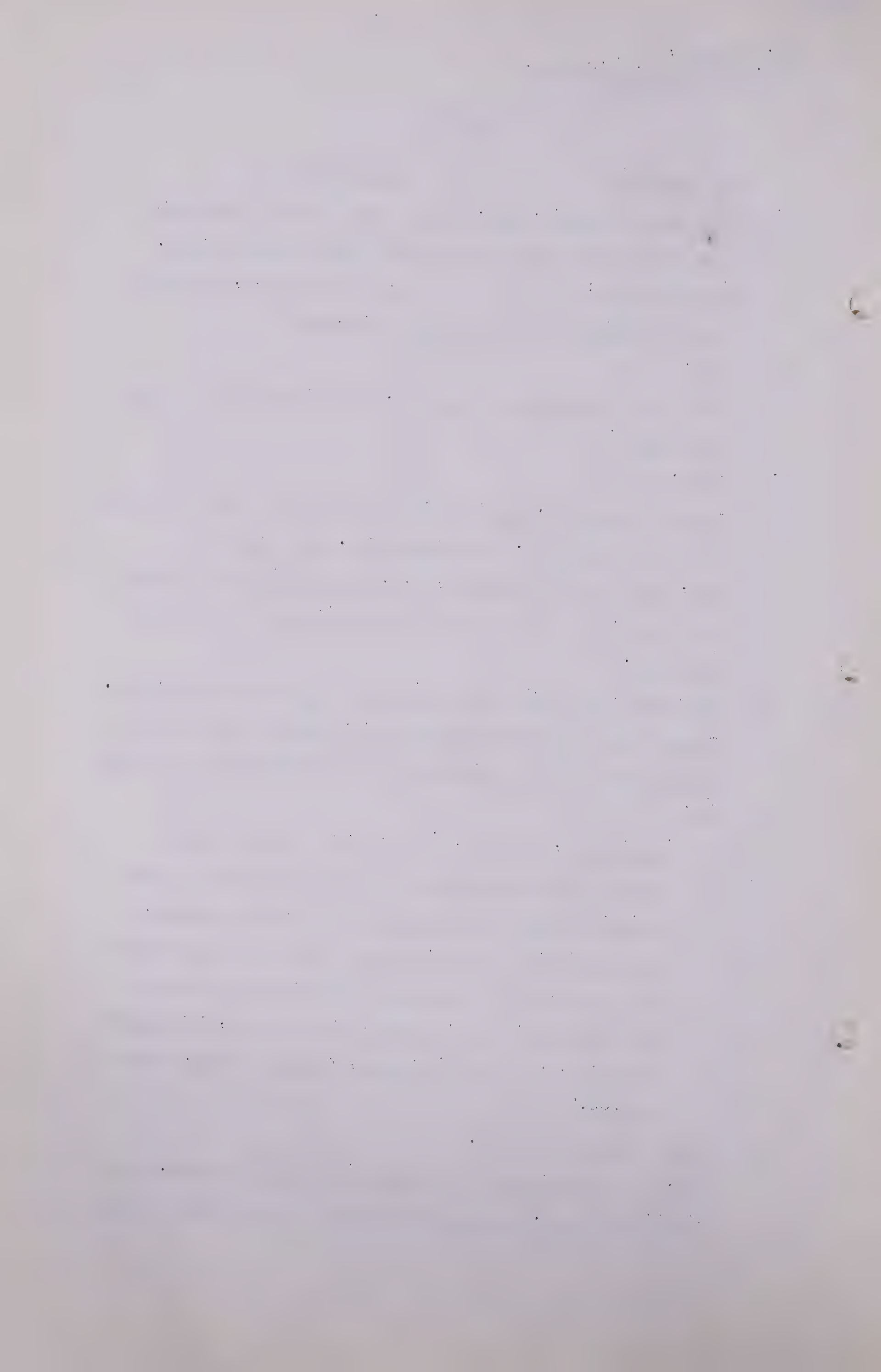
A Yes, that was the average, 2.6, but I think Mr. Wilkins has some very good figures on porosity that will be of interest.

Q Now, then, you have dealt with the matter of production. I was interested in whether your company is giving consideration to this paragraph in the Interim Report, page 46.

"Meanwhile, however, in the lack of any scheme which seems reasonable from the viewpoint of the owners of the reserves and the C.W.N.G. system, the Board can not declare any gas from the following fields to be surplus to the requirements of the Province: Black Butte, Manyberries, Princess-Patricia, Pendant d'Oreille, Pincher Creek, Smith Coulee."

A Yes, I have read that.

Q Now, as I understand the submission you have made, it amounts to this, that your proposal is to operate this



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Cr. Ex. by Mr. McDonald.

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field as your company feels it should operate it and to dispose of the gas without concern to the requirements set up by the Board and the evidence as presented by Mr. Davis the other day?

A No, I do not think that is a correct statement. Going back on the same page 46, we took into consideration in the Board's Report paragraph 2 on that page, where it states:

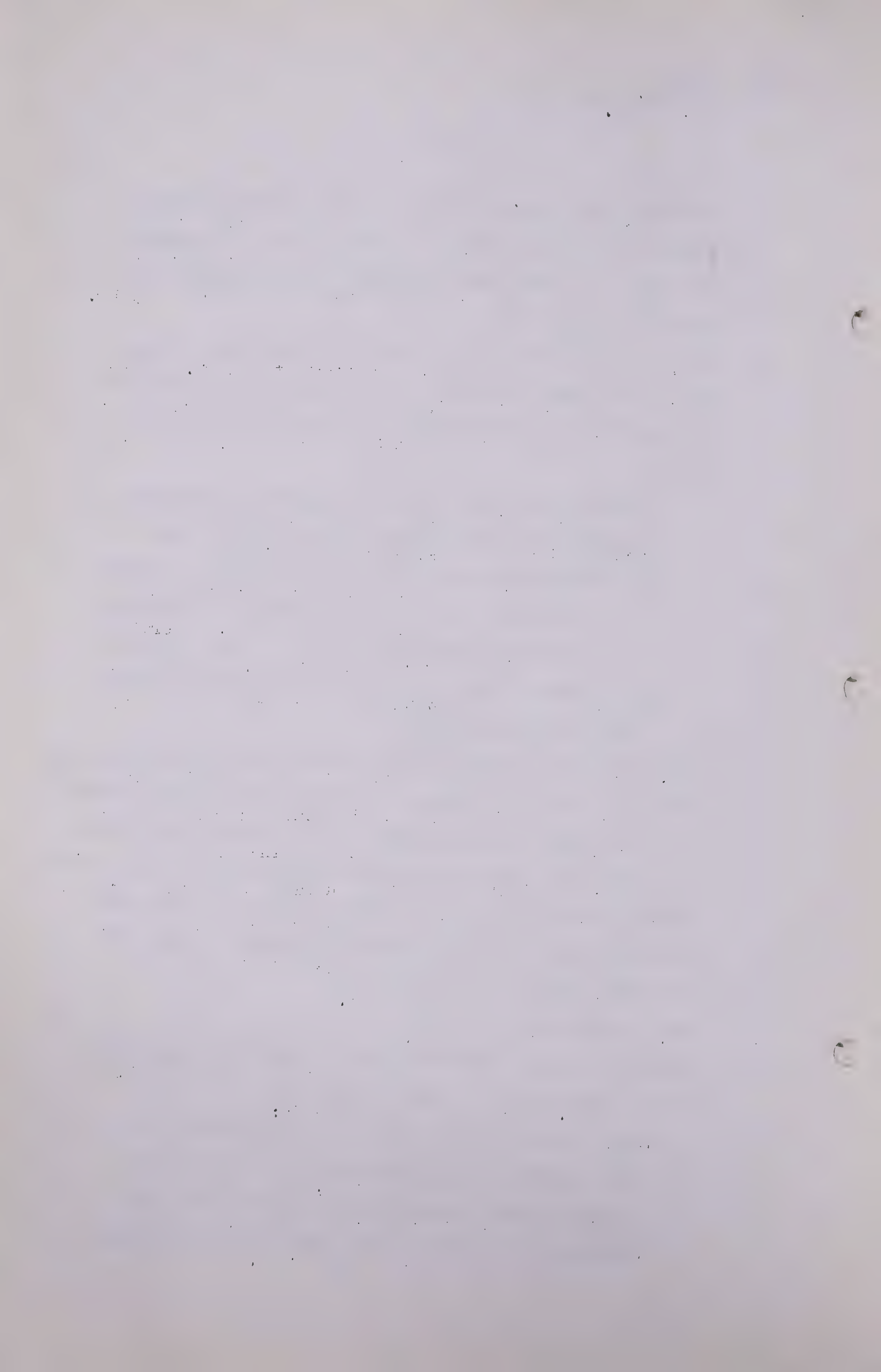
"From the point of view of the C.W.N.G. system the acquisition of the Pincher Creek field to meet its deficiencies does not appear attractive unless it is the only solution of the problem. Operating costs including depreciation would mean expensive gas which no doubt would be discouraging to future industrial development."

Q Now, just let us look at that. If you see in the preceding paragraph part of the Report, the Board is referring back to its analysis of the operations of Pincher Creek field, is it not, the fourth paragraph on page 45 in which it sets out the difficulties which would be found in developing the field only for meeting the requirements of the Canadian Western Natural Gas system.

A Yes, I think that is right.

Q Then did you give consideration to the other suggestion of the Board, which is also on page 46:

"What seems to be needed is the development of some further dry gas reserves, the planning of a future peak sharing storage project, and the integration of the dry gas reserves, the storage



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Cr. Ex. by Mr. McDonald.
Cr. Ex. by Mr. Martland.

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"scheme at Pincher Creek, to meet jointly the requirements of the C.W.N.G. system and some export market proportionate to the increase in reserves."

A Whereabouts is that?

Q I am sorry, Mr. Gray, that is the fifth paragraph on page 46.

A Yes. I think that is all dependent on the feasibility of the storage project. I certainly agree that additional gas reserves for peak sharing would be desirable.

Q Have you given any consideration to such a scheme, done anything about that particular problem?

A We have not been approached on it.

CROSS-EXAMINATION BY MR. MARTLAND:

Q Mr. Gray, you have defined in the last paragraph of your submission the nature of the adequate market which your company would like to obtain. That is as to quantities, I take it?

A Yes.

Q And you have made some investigations with regard to the Pacific Coast market in view of the fact that natural gas is not presently being served there?

A Yes, sir.

Q You are not suggesting that that is the only market available which could purchase gas from Pincher Creek?

A No.

Q In volumes in which you want to sell it?

A No, I do not.

F. L. Gray,
Cr. Ex. by Mr. Martland.
Cr. Ex. by Mr. Steer.

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Q And your company, I think, has information which indicates that Western Pipe Lines serving Saskatchewan, Manitoba and Minnesota could provide the sort of market as to volume which your company would like to have?

A Yes, we know there would be a very large market in the mid-West area.

MR. C.E. SMITH: Include Ontario and save Delhi getting up here.

CROSS-EXAMINATION BY MR. STEER:

Q Mr. Gray, you thought Mr. Davis did not know a great deal about Pincher Creek, and I would like to find out whether he did or did not. You tell us that Bonertz was how many feet, was 207 feet higher than Pincher Creek No. 1, and 513 feet higher than Walter Marr No. 1. What is the difference in height between Walter Marr No. 1 -- that is the lowest one, isn't it?

A Walter Marr is lower, yes.

Q What is the difference between Walter Marr No. 1 and Schrempp?

A You say those figures were 503 and 207? It would be 305, 306.

Q So that Schrempp would be 306 lower?

A You are speaking of the Schrempp or the Marr?

Q I am speaking of the Schrempp.

A It is 207 feet as compared with Pincher Creek No. 1. Pincher Creek No. 1 is 207 feet lower than Bonertz.

Q Quite so.

A And the Walter Marr was 513 feet lower.

F. L. Gray,
Cr. Ex. by Mr. Steer.

- 1408 -

Q Than --

A Than the Bonertz.

Q Well, the, how much lower is the Schrempp well than the Bonertz well?

A 744 feet lower than Bonertz.

Q Would it be true to say that these three wells, Bonertz and Pincher Creek No. 1 and Walter Marr No. 1 are generally along the trend of the axis of that structure?

A It certainly is not along the crest.

Q No, I am not suggesting it is along the crest, but I am suggesting it is along the trend of the axis, those three wells are along the trend of the axis?

A Well, you could say that. Pincher Creek No. 1 is about half way, about the middle of the field east and west.

Q Let us get at that, the Schrempp well is on the east side?

A The extreme west edge.

Q The extreme west edge?

A That is right.

Q Now, if you proceed east, the next well you come to is -

A Pincher Creek.

Q And how far is it east and west between Schrempp and Pincher No. 1?

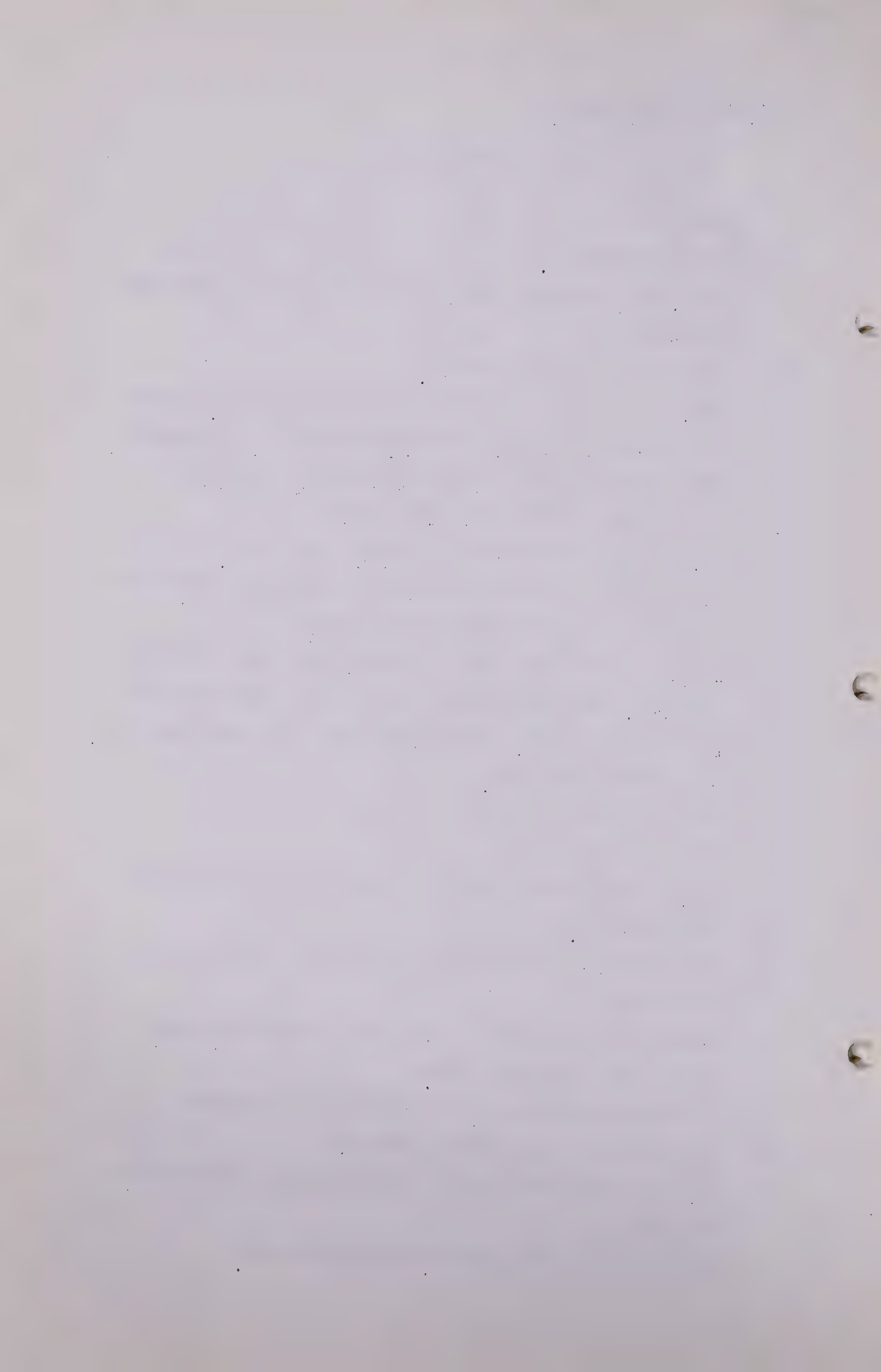
A Pincher Creek is about a mile and a quarter east and a mile and a quarter south.

Q I am only interested in the east-west distances.

A Did you want the diagonal distance?

Q No, you have given me the east-west horizontal distance as what?

A About a mile and a quarter, mile and a half.



F. L. Gray,
Cr. Ex. by Mr. Steer.

- 1409 -

Q I think you said that that line would not pass perpendicularly across the structure in your opinion?

A No. The east-west line?

Q Yes?

A No.

Q Give us the diagonal distance then on a line that would pass perpendicularly across the structure?

A Well, the structure is not in a straight line but in that particular area it would be about three-quarters of a mile.

Q Yes?

A From the projection.

Q And there would be three-quarters of a mile between the Schrempp well and the projection of Pincher Creek No. 1. In which direction?

A Pincher Creek No. 1 in a northwesterly direction.

Q Yes. Well, then, will you take the same kind of a computation with regard to Pincher Creek No. 1 and the next one east?

A Pincher Creek is the furthest east.

Q Oh. Well, which is the nearest to Pincher Creek then towards the west?

A Schrempp No. 1. If you want to take a projection from Bonertz down along the strand of that portion of the structure, then the Schrempp would be $2\frac{1}{2}$, $2\frac{3}{4}$ miles from that projection but the pool curves in the meantime.

Q I see. And was that information as to the curving of the pool available from any examination of the record up to this time? I am suggesting to you that a man would be perfectly justified in thinking that these two wells,

F. L. Gray,
Cr. Ex. by Mr. Steer.

- 1410 -

Pincher Creek No. 1 and Walter Marr No. 1, were along the trend of that structure?

A They are along the trend of the structure only to the extent that the structure is long.

Q The structure is what?

A Is long. Structurally, it is not along the trend.

Q Now, there is one other thing, I understood, and I may have been wrong, that Mr. Wilkins had said, and you agreed, that the amount of gas that was actually got out of fractures would be 9 times the amount that would be got out of the denser portions of the rock?

A I am sure Mr. Wilkins did not say that.

Q You remember the passage I am referring to?

A He was talking about permeability, that the permeability of the fractures was 9 times that of the denser portion of the rock.

Q Yes, and I understood you to say that the gas in the denser portions of the rock would be produced much more rapidly than it otherwise would be by reason of these fractures?

A That is correct.

Q That is correct. But the proportion of the increase, I am wrong about that, eh?

A You might say that the fractures are the channels through which the gas will be produced.

Q Yes.

F. L. Gray,
Cr. Ex. by Mr. Bredin.

- 1411 -

CROSS-EXAMINATION BY MR. BREDIN:

- Q Mr. Gray, on page 4 you state that Pincher Creek is not a field that can be developed and operated economically on a small scale apart from removing sulphur and other liquid components. What are the other factors that make it economically expensive to operate on a small scale, if there are others?
- A If it was possible to sell this gas directly to the pipeline without any plants at all it could be produced at a reduced scale, but it would be economically wise to not extract the sulphur and certainly would not be a conservation measure, and the size of the plant also was dictated somewhat by the type of gas you are treating. In other words, that gas has a very low content and it takes large plants in order to make an economical operation.
- Q Subject, of course, to any export permits, has your company given any options or firm contracts for the sale of its gas at this time?
- A None that I know of.
- THE CHAIRMAN: Thanks, Mr. Gray.
- MR. FENERTY: Might I clarify one point before I call Mr. Wilkins.
- Q I think you gave a figure on closure of 1,000 feet and also gave a crest of 6800 feet below sea level. What is the elevation of your gas-water contact?
- A The elevation of the gas-water contact is 8200 and the crest contour line is 6900, which would give a closure of 1300 feet.
- Q In your estimate of reserves, you discounted --

F. L. Gray,
Cr. Ex. by Mr. Bredin.
Exam. by Dr. Govier.

- 1412 -

A The last 100 feet.

Q Entirely?

A That is right.

EXAMINATION BY DR. GOVIER:

Q Mr. Gray, I have one or two questions I wanted to ask.
When do you expect core analyses will be available for
the Bonertz well?

A We are making both hole core analyses and plug analyses
on there, I believe, and that is rather a slow process.
About two months, something like that. I am thinking
about 60 days.

Q Within about two months?

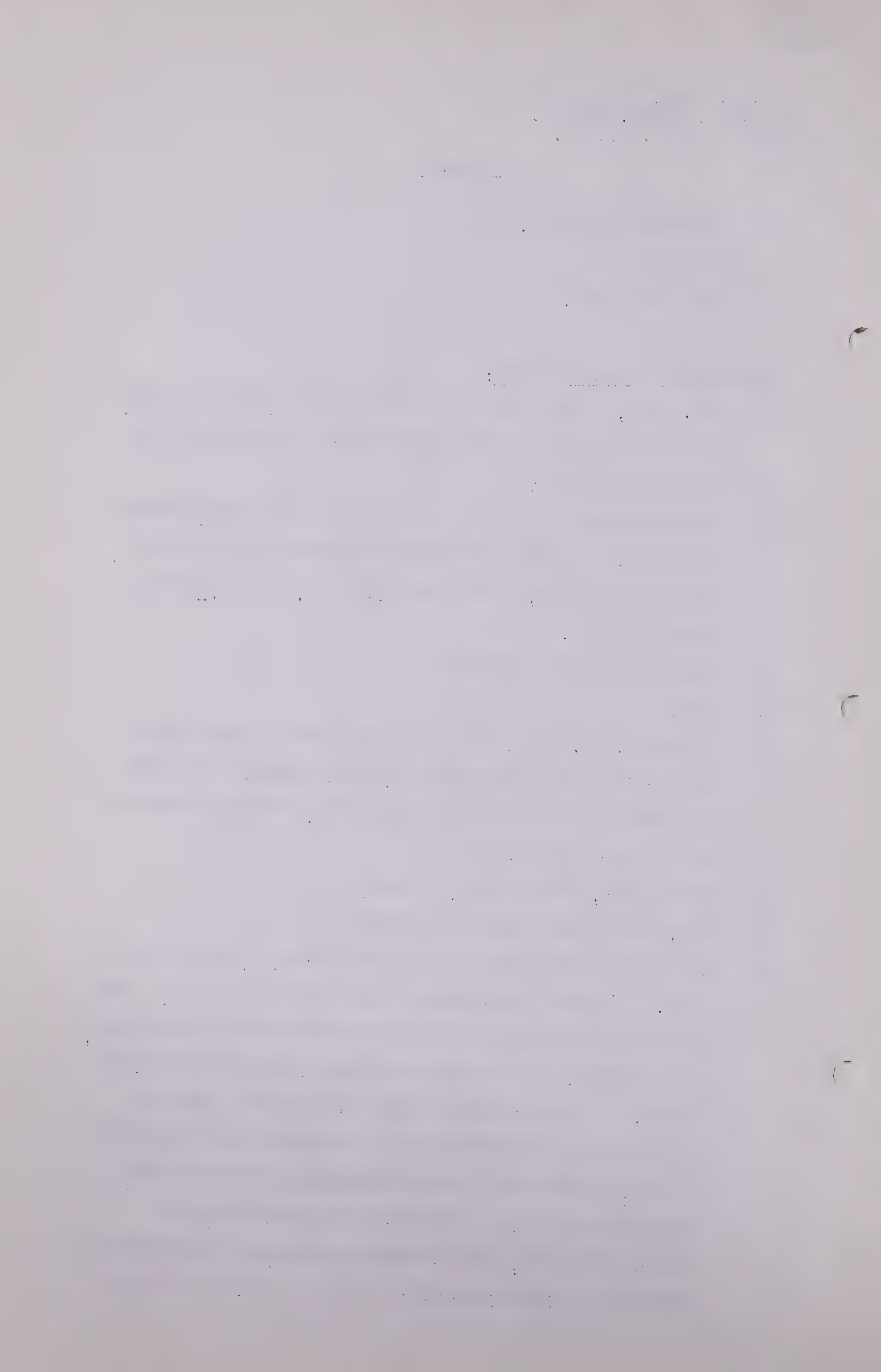
A Yes.

Q I notice, Mr. Gray, that you had assumed a reasonable
production rate of 20 million, which happens to be 25
per cent of the 80 million open flow. Did you arrive at
that figure that way?

A 20 million, 25 per cent, I mean?

Q Yes, or is that just fortuitous?

A We thought that might be the limitation. We just used
that. I think I mentioned before that as near as I can
find out the 25 per cent figure was arrived at years ago,
about 1913, when the first Oklahoma conservation law was
passed. On that 25 per cent I thought we ought to
consider the conditions which existed at that time where
gas wells were very frequently blown in the hope they
would come on oil. There was no restriction of
conservation laws, and actually an operator was somewhat
obligated to blow his well in order to protect it from



F. L. Gray,
Exam. by Dr. Govier.

- 1413 -

drainage. The passage of that law modified the law of capture, but in our studies on this reservoir we could find no scientific information that the rate of production in the Pincher Creek field would have any effect whatever on the ultimate recovery of all the products.

Q I take it, then, that you would not take exception to the proposals made by Dr. Brokaw, Dr. Hetherington and Mr. Hawthorn to the effect that the 25 per cent figure might well be increased?

A That is right.

Q Have you any ideas on what might constitute the ceiling figure expressed as a percentage of open flow or any other way?

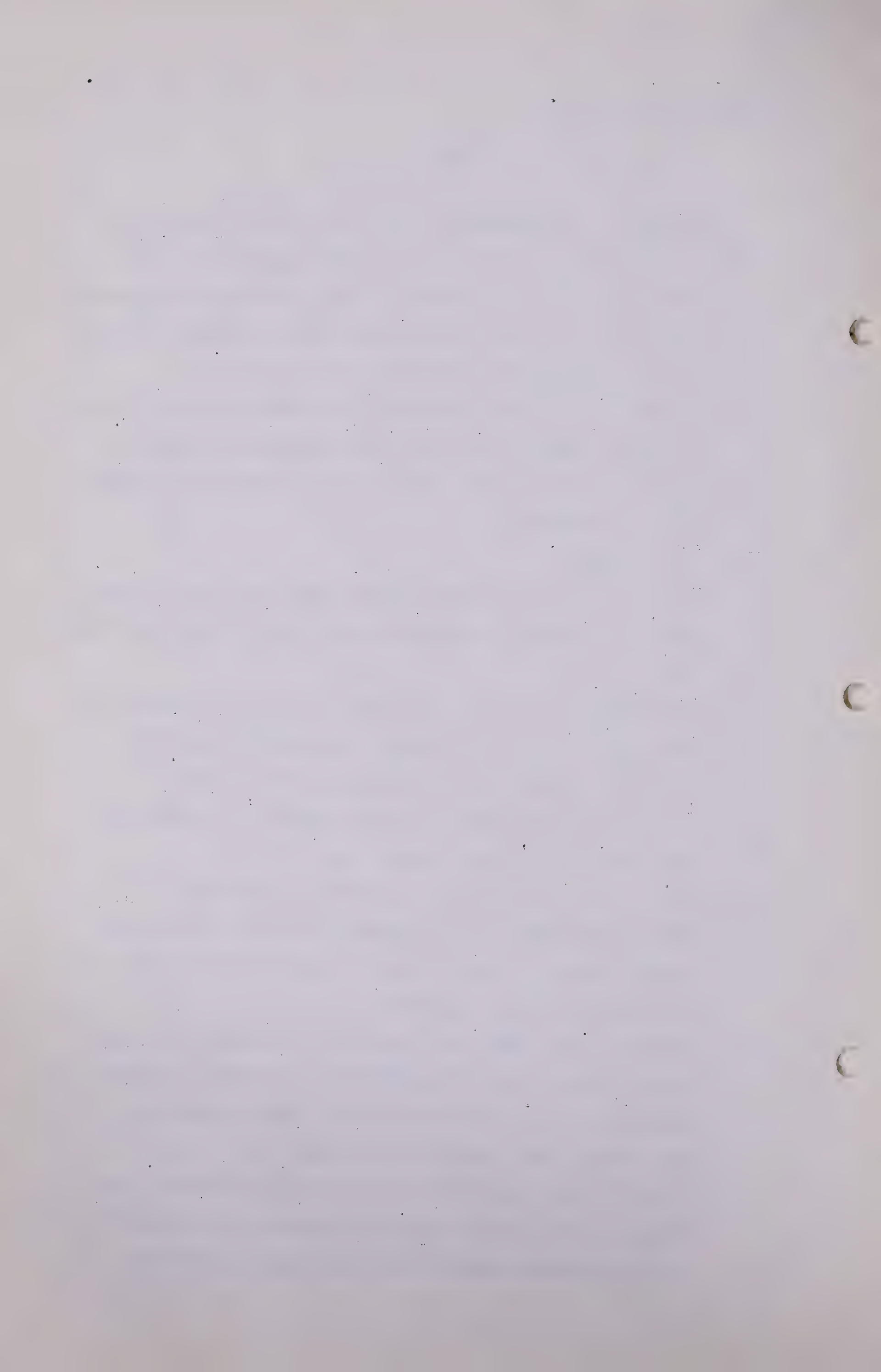
A For practical reasons you might not want to produce it wide open but so far as effect on conservation in the reservoir is concerned I would say 100 per cent.

Q It would not worry you at all to produce, from what you now know, at 50, 60 or 75 per cent?

A No. I think the controlling feature there would be to deplete the reservoir in approximately the same period as the plant will last, considering obsolescence and corrosion and other features.

Q On page 4, Mr. Gray, you say that it is essential that Pincher Creek field be assured of a relatively uniform producing rate. Could you express that in terms of a load factor, percentage load factor?

A I would rather not talk in terms of load factors. You might look at it this way, the extraction of sulphur is a rather touchy proposition of burning the hydrogen



F. L. Gray,
Exam. by Dr. Govier.

- 1414 -

sulphide, only a portion of the hydrogen sulphide, such that you have exact portions of hydrogen sulphide SO_2 all combined to drop it into sulphur, and that is a type of operation that will stand for no quick fluctuation. And even the same thing is true to a lesser extent on your extraction of gasoline plant products. The variations there will knock the efficiency of the recovery of your product, and in our discussions on that point we have been thinking in terms of a variation not exceeding 20 million cubic feet a day. Now, that may be kind of a rule-of-thumb arrangement.

Q I do not understand you there.

A A maximum variation from average to peak of 20 million cubic feet a day.

Q That is, if your average was 150 you would not want to have to handle a peak in excess of 170?

A That is correct.

Q Have you taken that into account when you say at the bottom of page 4 that it is believed that a market exists, etc. Does a market exist that has that load factor requirement, Mr. Gray?

A I question whether that load factor could be achieved the first year in the early life of the pipeline, but at that point we would have to be building a plant for future markets so that our pipeline could take a little bit more variation, but the same thing would be true although we could stand it as far as the plant is concerned, the efficiency of the recovery of sulphur would be bothered.

F. L. Gray,
Exam. by Dr. Govier.

- 1415 -

Q Would the Board be correct in interpreting what you have said as meaning that in your opinion the Pincher Creek field could be treated on such a basis that the ratio between average and maximum per day output should never fall below, say, 150 divided by 170? Is that a fair enough interpretation?

A I would not say enough, but I think that is desirable.

Q It would be close to that?

A Yes.

(Go to page 1416)

F. L. Gray,
Cr. Ex. by Mr. Steer.
Cr. Ex. by Mr. McDonald.

- 1416 -

CROSS-EXAMINATION BY MR. STEER:

Q Mr.Gray, will you discuss retrograde condensation if you produce the well to the full capacity?

A I do not think there would be any difference. In fact, I wonder if it would not increase it a little bit? There is bound to be a drop in the formation and near the well bore, and it certainly is going to get enough saturation of liquids in there. Now, the high velocity might give you an insignificant additional recovery, but I do not believe it would be enough to amount to anything.

.....

CROSS-EXAMINATION BY MR. McDONALD:

Q Just one question, Mr.Chairman, arising out of Dr. Govier's remarks. You mentioned the 80, and you had agreed with me previously with the 80 million open flow with regard to a well?

A Yes.

Q I am looking at the first page of your submission, and I know that it says that the 30 million feet per day flow was stabilized for a period of 6 hours?

A Yes, that is right.

Q Now, we have evidence before us that in the Viking field the flow was as high as 17 million on a 10-hour test, and then on a 10-day test it dropped to as low as 11 million cubic feet per day. Now, I am wondering as to what would be your thought with regard to a similar test on the Pincher Creek field?

A The potential might go down some. I question it, however.

F. L. Gray,
Cr. Ex. by Mr. McDonald.

R. B. Wilkins,
Dir. Ex. by Mr. Fenerty. - 1417 -

I am not familiar with Viking.

Q It is a sand?

A It is a sand?

Q Yes?

A Well, then, it is entirely different than this fractured thing that we have in this reservoir.

Q That is what I want to bring out, if you have not got the fractures, you are going to go down a lot faster than you will if you have the fractures?

A That would be a correct statement.

Q And if you have only this small porosity the deliverability of your particular wells would be very seriously impaired as they are drawn down at high rates over the extended period of time?

A Yes.

MR. FENERTY: If there are no more questions, Mr. Gray might step down and I will ask Mr. Wilkins to take the stand to deal with some of these questions that have been left up in the air.

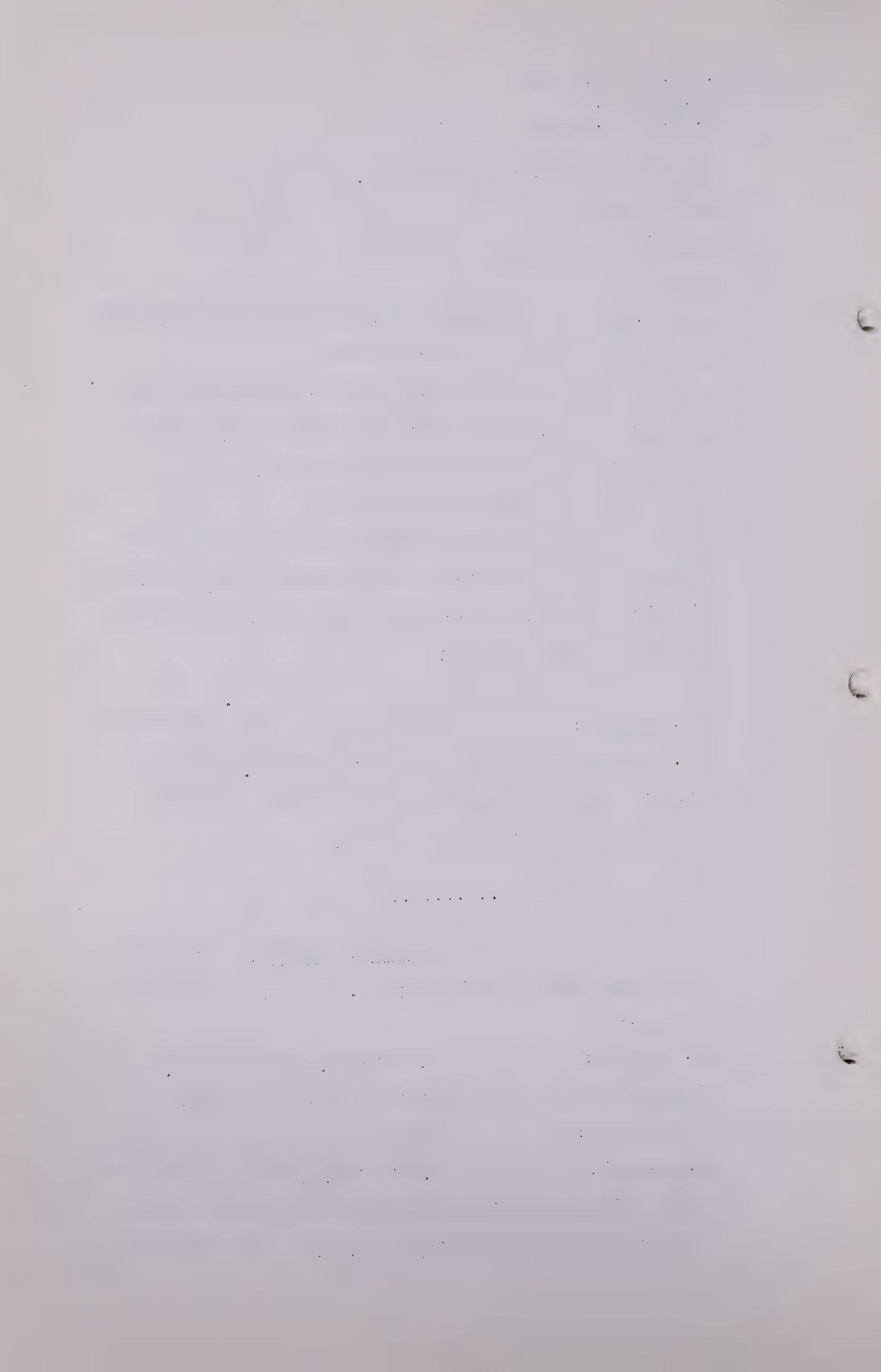
.....

ROBERT B. WILKINS, having been first duly sworn, examined by Mr. Fenerty, testified as follows:-

MR. FENERTY: Mr. Chairman, I believe Mr. Wilkins has also been qualified before the Board?

THE CHAIRMAN: Yes.

Q MR. FENERTY: Mr. Wilkins, we have heard that these estimates of Pincher Creek reserves have been based on an average porosity of 2.6%. Can you give



R. B. Wilkins,
Dir. Ex. by Mr. Fenerty.

- 1418 -

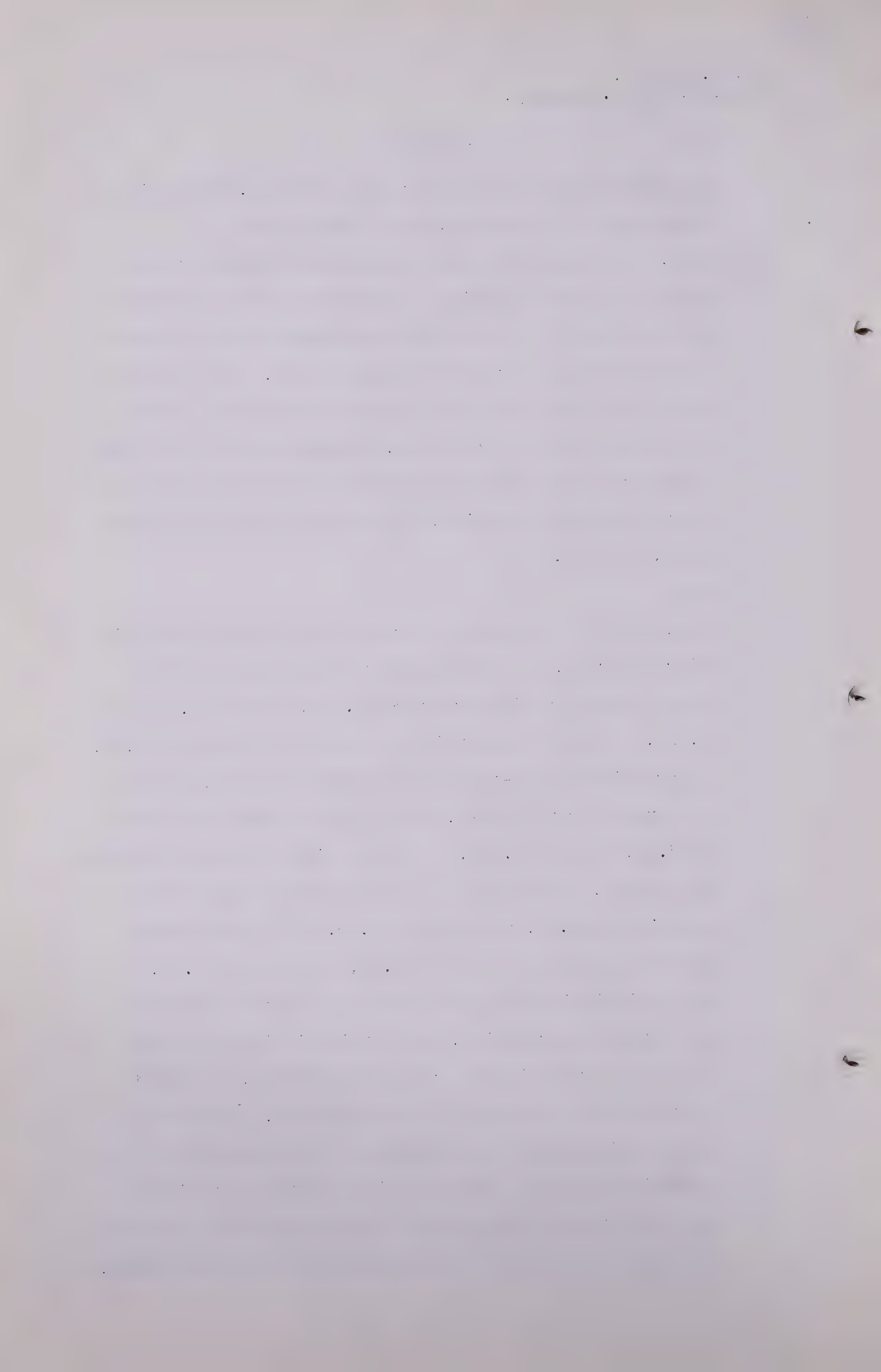
the Board some actual figures on porosity, and having regard as to how the 2.6% was arrived at?

A Yes. I discussed this at considerable length at the time of the last Hearing. A number of the plugs which were measured as to porosity and permeability, in some cases they had no measured permeability. In instances where they were observed to have any fractures, or be in a zone that was fractured, this portion that the plug represented was discarded from the over-all net section, even though the porosity, as measured, might be as high as 3, 4 or 5%.

Q Yes?

A Now, actually the porosity in the Upper Dense member in Pincher Creek, the average plug porosity in the Upper Dense member in Pincher Creek No. 1 and Marr No. 1, was 4.32%. In our calculations we used an average of 1.50, or practically one-third of what was measured, and in the Upper Porous member, which had a measured porosity of 7.6%, we used 6.42%. In the Middle Hard and Crystalline zones, in that zone or zones we had a measured porosity of 3.46, and we used 0.09. The Lower Porous had a measured porosity of 2.64, and we used 1.62. From this is indicated the degree to which we reduced the measured porosities, and I think it is an attempt to evaluate what is the producing porosity. We might be criticized and we have not criticized, or we have been criticized in some instances for being unduly conservative in these reductions in effective porosity.

Q And your average porosity was obtained by thus averaging the figures that you had, by measuring the porous zones,



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Dir. Ex. by Mr. Fenerty. -

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the thickness of various zones, and discarding various portions?

A Yes.

Q As a weighted average?

A It is a volumetrically weighted average, and the 2.6% was arrived at by taking the total measured core volume over the entire areal extent of the field, and dividing it into the bulk volume, in other words, the gross thickness.

Q Mr. McDonald asked a question of Mr. Gray, with respect to the carrying out of the "n" slope, and perhaps you can elaborate on that question, and I would like you to deal with that?

A In the submission by one of the applicants here, they presented some calculation in which they referred to the Bureau of Mines type tests, and they said that they used a slope of, the curve of 1.15. Now, ordinarily in the Bureau of Mines tests, if we follow monogram No. 7, the plot would be $P_f^2 - P_s^2$, and the P_f is the formation pressure under static conditions, and the P_s is the pressure at the sand face under flowing conditions, and that is applied as the ordinant, with the "Q" as the rate of flow, the cubic feet per day, and that is applied as the abscissa. Now, if we had the slope suggested by the applicants in the manner they have, I would not be able to duplicate the sand face pressure draw-down which they present. They used for the well as an open flow potential, open flow capacity or potential, of 70 million cubic feet per day, and that if it is produced at one-quarter of that rate, or $17\frac{1}{2}$ million cubic

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feet per day, and they have a draw-down of 800 pounds per square inch. I attempted to duplicate their curve, and I found they had utilized the reciprocal of the slope. In other words, their slope was about .87. We have actually used in plotting, as I have indicated, a slope of 1.15, which would have a draw-down of about 600 pounds, or something like that, 653 pounds, I think that figure is. I think I have that figure here.

MR. McDONALD: Mr. Chairman, I do not want to interrupt the witness, but Dr. Hetherington tells me that the reciprocal that he had reference to was the Delta Q over Delta P², and that that was gone into detail by cross-examination by Dr. Govier, and as indicated in the evidence of Mr. Wilkins he has reversed them. In other words, his reciprocal is upside down.

A May I ask a question of Dr. Hetherington?

MR. McDONALD: Yes, go ahead?

A Mr. Chairman, may I ask Dr. Hetherington a question?

THE CHAIRMAN: Yes.

THE WITNESS: Ordinarily do not they plot in deliverability in the Bureau of Mines P_f^2 over P_s^2 as the ordinant and Q as the abscissa?

DR. HETHERINGTON: That is right, but defined in the formula, or in the book, this "n" appears as a power of the Delta P² term.

THE WITNESS: Do you often find a curve of 1.15 in that relationship?

DR. HETHERINGTON: No, that is as we pointed it out, and Dr. Govier brought it out in the cross-examination, that that is a rather averaging slope but

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characteristic of wells of liquefied contents.

A Well, I would like to point out to the Board that all of our measured bottom hole pressures in the Pincher Creek field, we conducted tests where we measured the flowing bottom hole pressure of the Pincher Creek No. 1, and on the Bonertz No. 1, and the slope in both instances was identical at 1.5, and where it is applied in the manner in which I gave indicated, it would be the reciprocal of that in your case.

MR. C. E. SMITH: Is it the right side up now?

A In other words, our draw-down, producing at approximately 30 million cubic feet per day, was only 583 pounds, and yet Dr. Hetherington has indicated that flowing at the rate of $17\frac{1}{2}$ billion cubic feet per day the draw-down was 800 pounds. There is a vast difference in the two figures.

MR. FENERTY: Would you care to go further into this point, Mr. McDonald?

MR. McDONALD: Yes.

THE CHAIRMAN: Probably it would save some time if Dr. Hetherington asked the questions.

MR. McDONALD: All right. I think I have a couple of questions I want to ask.

Q One question I had, sir, was that in this exhibit, that is Exhibit 80, in the Westcoast Transmission case, the column No. 1, the line No. 1, and you have seen it before, as I understand it, it shows a slope of 1.2?

A That is correct.

Q Yes?

A That test was based upon measured well head pressures, and

R. B. Wilkins,
Dir. Ex. by Mr. Fenerty

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the flowing bottom hole pressure was calculated in the manner suggested by the Bureau of Mines. However, tests No. 2 and No. 3 which we have previously submitted in evidence at another hearing, we showed that those were measured bottom hole pressures in each case, and the slope is 1.5, as is curve No. 4 here, and is substantiated by our test on Bonertz No. 1.

MR. FENERTY: Are there any further questions by the Board or anyone? Well, I will go on anyway to the other point.

Q The other point I want to deal with is a highly hypothetical question which was raised by my learned friend as to the slope of the sole fault, the fault to the east of the field. I think Mr. Gray mentioned it, and that it perhaps cannot be too great because it was not encountered by the Bonertz well. But let us suggest, just theoretically take a slope of 30% off perpendicular off this fault, that is, a slope to the west, how materially would that affect the estimates of reserves?

A If it is 30% from perpendicular - you mean from vertical?

Q Yes, from vertical?

A Yes. It would not affect it over 5%, some such thing, beyond the accuracy of our estimates.

Q If it were a slope off vertical, then it follows that it would extend the estimate?

A Yes, that is true.

Q The estimate is based on a vertical fault?

A Yes.

Q In the absence of information?

A Yes.

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Q Indicating the actual slope?

A Yes.

Q There is some mention of a figure whereby the estimate might be reduced by about as much as one-third, and I believe they mentioned a figure of 30% off horizontal, but I am not sure. What chance is there, in your opinion, of the possibility of their being a slope of 30% off horizontal, both geologically and in your experience?

A I think it is physically possible, but improbable. As Mr. Gray pointed out, if there had been that kind of a fault, then we would have encountered that in our Bonertz No. 1. If there had been that acute an angle with the horizontal, then it would have cut off for the most part the lower members of the Madison limestones which do not contain the major portions of the reserves in the Pincher Creek field.

Q Well, this might be highly hypothetical or very theoretical, and I think it is entirely in the field of speculation, but let us suppose that this is a 30% slope off horizontal, and it has a tendency to slope to the west, 30% off horizontal, and having regard to the nature of the formations which you have got, to what extent would it, in that hypothetical case, reduce the estimates of reserves? We had a figure of one-third? Do you agree with that?

A That assumes, I presume, an entirely homogeneous section throughout the Madison limestone. Actually, I would not anticipate that would reduce the reserves by more than 12%, or some such figure, 12 or 15%.

Q That is, if it were 30% off horizontal?

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Dir. Ex. by Mr. Fenerty.
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A 30° off horizontal.

Q Yes. And you would further anticipate that that would be, or your opinion is that that 30° ought to be regarded as an entirely theoretical figure?

A Yes.

Q Not a practical figure?

A Yes.

Q In this case?

A No.

Q I think that is all. Will you just answer any further questions?

.....

CROSS-EXAMINATION BY MR. McDONALD:

Q Mr. Wilkins, I was just interested in your calculations of porosity, and as I understand it, you get down to 1.62% in the Lower Porous? I think your figure there on the actual reading, the lowest one, was 1.62%?

A Something like that.

Q Well, I understood your evidence last year was that it was something in the neighbourhood of 1% in the vicinity of the Schrempp well?

A Well, actually we had those cores analyzed by one of the local laboratories in the section that was penetrated in the Schrempp No. 1, and it gave us an average porosity of 3.14%, and in our own laboratory we measured, I have forgotten what it was - I have lost my slip.

MR. C. E. SMITH: You put it in your pocket.

A I have it now. It was 2.64, and we used 1.6.

Q MR. McDONALD: Yes?

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A. So that the 3.14 compares rather favourably with the 2.64 that we measured in our laboratory.

Q And that is what you were referring to as the 1% in your evidence of last year? I can look up the reference for you?

A That is true.

Q Now, we come again to this question of deliverability production, the deliverability that you have calculated, the wells in the fractured section, which are the three wells we know of today, they are in the fractured part of the structure?

A I would not limit that fractured part to the section they are drilled in.

Q You would not limit that fractured part to the section that they are drilled in?

A No. I will say they are fractured.

Q Then we come to your deliverability, and your average well, the average based on those three wells, that will not be applicable to wells, say, drilled in the vicinity of the Schrempp well, if that condition continues in that area?

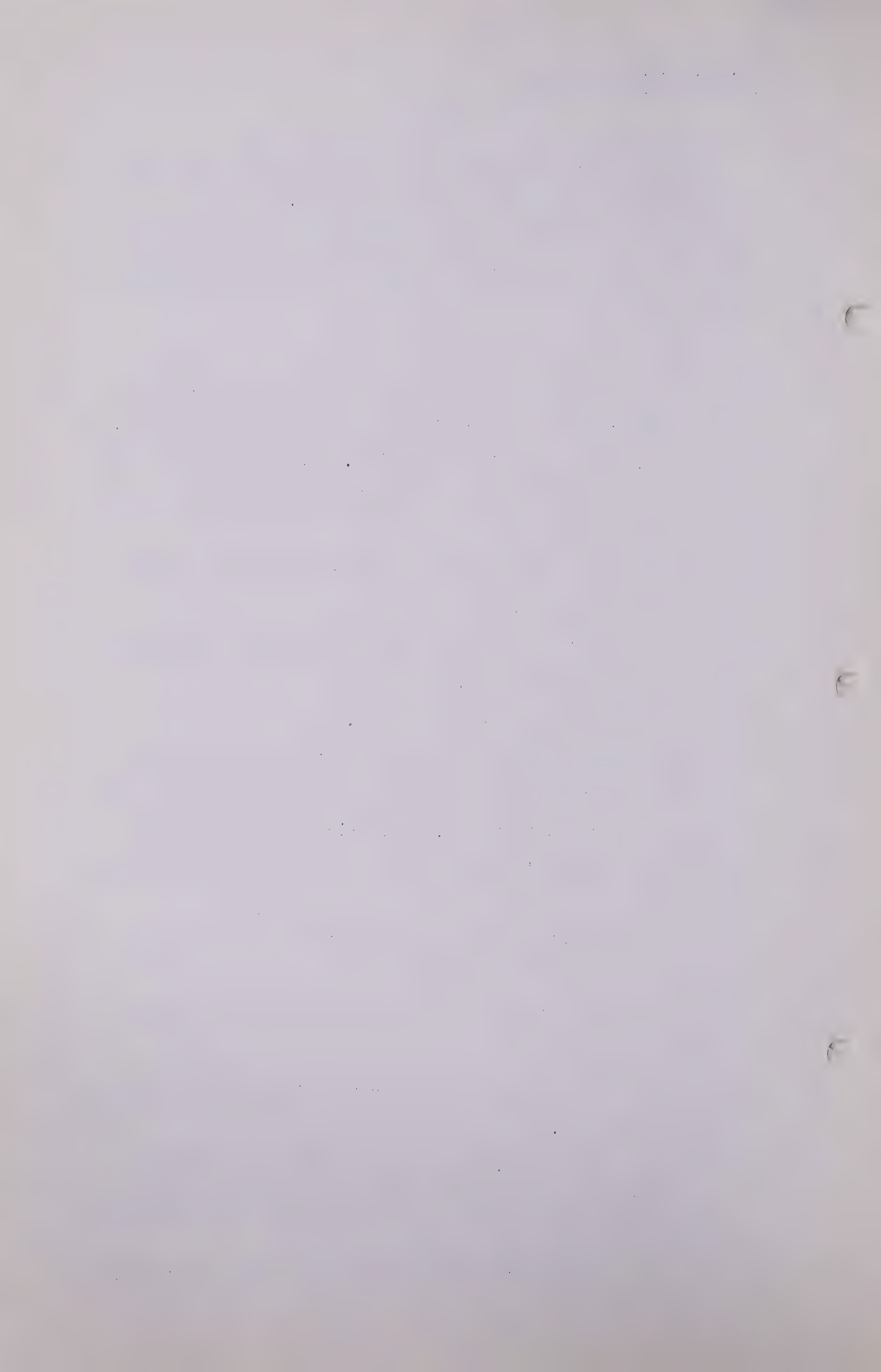
A I doubt very seriously if we will drill any more wells in the vicinity of the Schrempp well.

Q I was interested in how you are going to get 24 wells unless you do?

A There is no spacing out there for the Pincher Creek field, no spacing order.

Q Oh, yes, that is right. Your proposition is based in operating the field according to your own engineering information?

A I think it would be foolish not to use the best engineer-



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ing information available to develop our spacing pattern. Now, you were going to tell me the capacity of the field with regard to the production in the fifth year, the fifteenth year, and the twentieth year. That is the average well, I take it?

A What average producing rate would you want?

Q I would prefer if you would refer to the Table that Mr. Gray referred to. Mr. Gray read from a Table in his exhibit which gave some proposed production from the field, and his average in the first year was 101 million cubic feet per day?

A Let me see? Give me the total cumulative production at the end of 5 years, what was that?

Q At the end of 5 years, 275 billion cubic feet.

MR. FENERTY: 255.

MR. McDONALD: No, it is 55 billion cubic feet per year, or a total of 275 billion cubic feet.

A One thing I want to point out, before we go into this, is that the deliverability of the well is dependent upon the wellhead pressure which is maintained on the well, and, also, obviously, to the size of tubing which is utilized. Now, we have made some calculations assuming 4-inch tubing in that case, and maintaining 1000 pounds wellhead pressure; after having produced the quantity mentioned previously we would be able to produce through a 4-inch tubing at the rate of approximately 37 million cubic feet per day per well.

Q Yes?

A On the basis of a theoretical open flow potential initially, at initial reservoir pressure from 80 million cubic



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feet per day.

Q That is the end of the fifth year, Mr. Wilkins?

A That is true.

Q Now, take at the end of the tenth year, 650 billion cubic feet for the 10 years?

A In that case a well produced against a well head pressure of 1000 pounds per square inch through 4-inch tubing, would be capable of producing at the rate of $19\frac{1}{2}$ million cubic feet per day, assuming an initial open flow potential of 80 million cubic feet per day, under initial conditions.

Q And that is producing at 100% open flow?

A This $19\frac{1}{2}$?

Q Yes?

A No, that is deliverability through 4-inch tubing.

Q I see?

A With 1000 pounds back pressure.

Q All right. I understand you now. What about the fifteenth year?

A What is the cumulative?

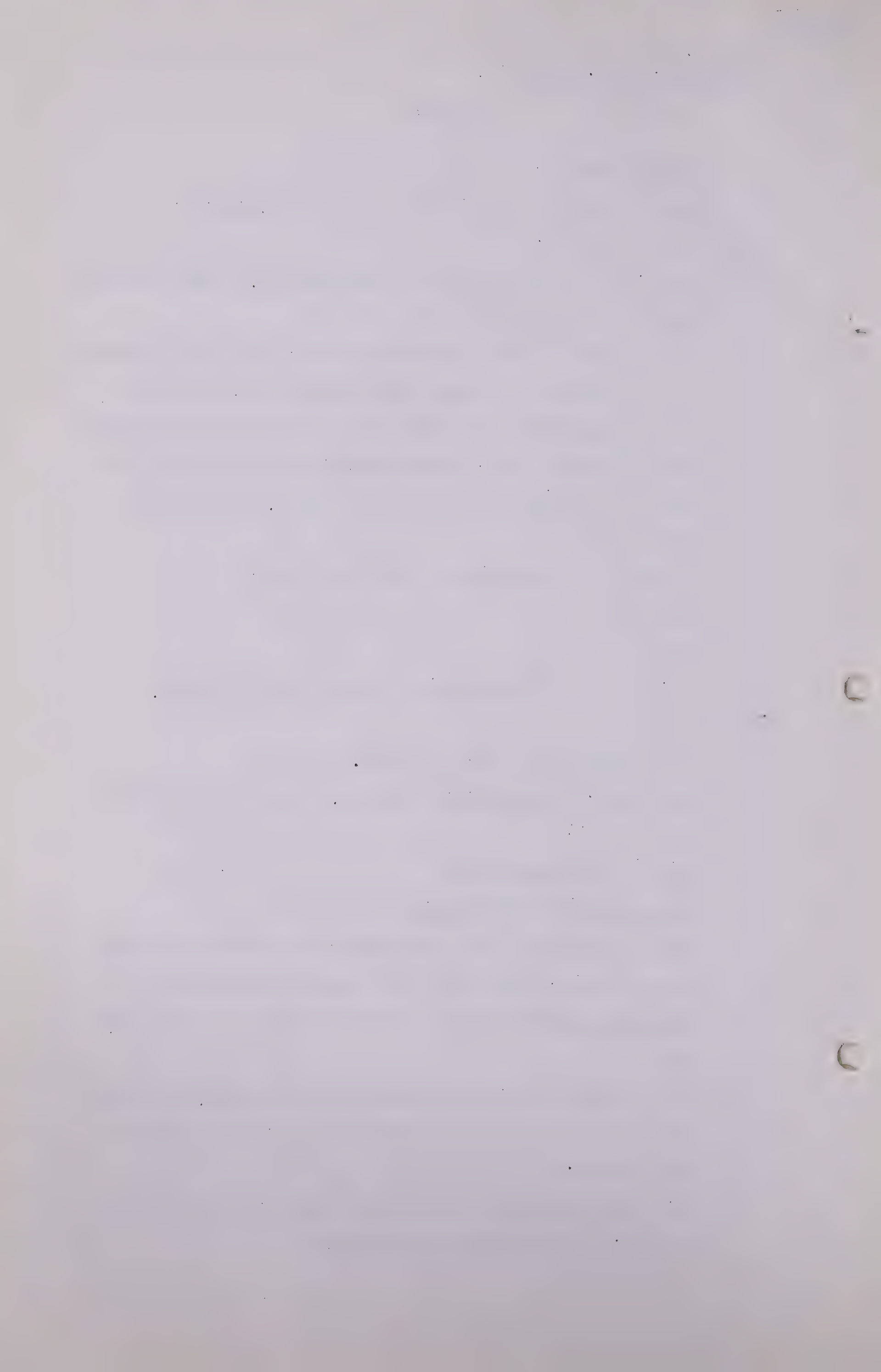
Q The cumulative 1025 billion cubic feet?

A With 1000 pounds well head pressure producing through 4-inch tubing, that same well would be capable of producing approximately $6\frac{1}{2}$ million cubic feet per day.

Q Yes?

A If we reduced the back pressure to 750 pounds, that same well would be capable of producing 10 million cubic feet per day.

Q Now, would you give me the same answer with regard to 20 years, 1400 billion cubic feet?



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A I would like to point out that all of these calculations here are based on gas measured at 14.7 p.s.i.a. The reason we have done that is because our model reservoir study, to which Mr. Gray referred, was conducted on that pressure basis.

Q Yes?

A Excuse me, what was that figure again?

Q 1400 billion cubic feet?

A This is gross gas that we are speaking of in all instances.

Q Marketable gas I am speaking of?

A I am speaking of gross gas.

Q I understand. You mean gas from the well head?

A Yes.

Q All right.

A In that case, of course, we would not be able to produce against a wellhead pressure of 1000 pounds, because our reservoir pressure had declined below that figure.

Q Yes?

A If it is assumed that we produce that well against a back pressure of 100 pounds per square inch through 4-inch tubing, the resulting indicated deliverability would be approximately $3\frac{1}{2}$ to 4 million cubic feet per day.

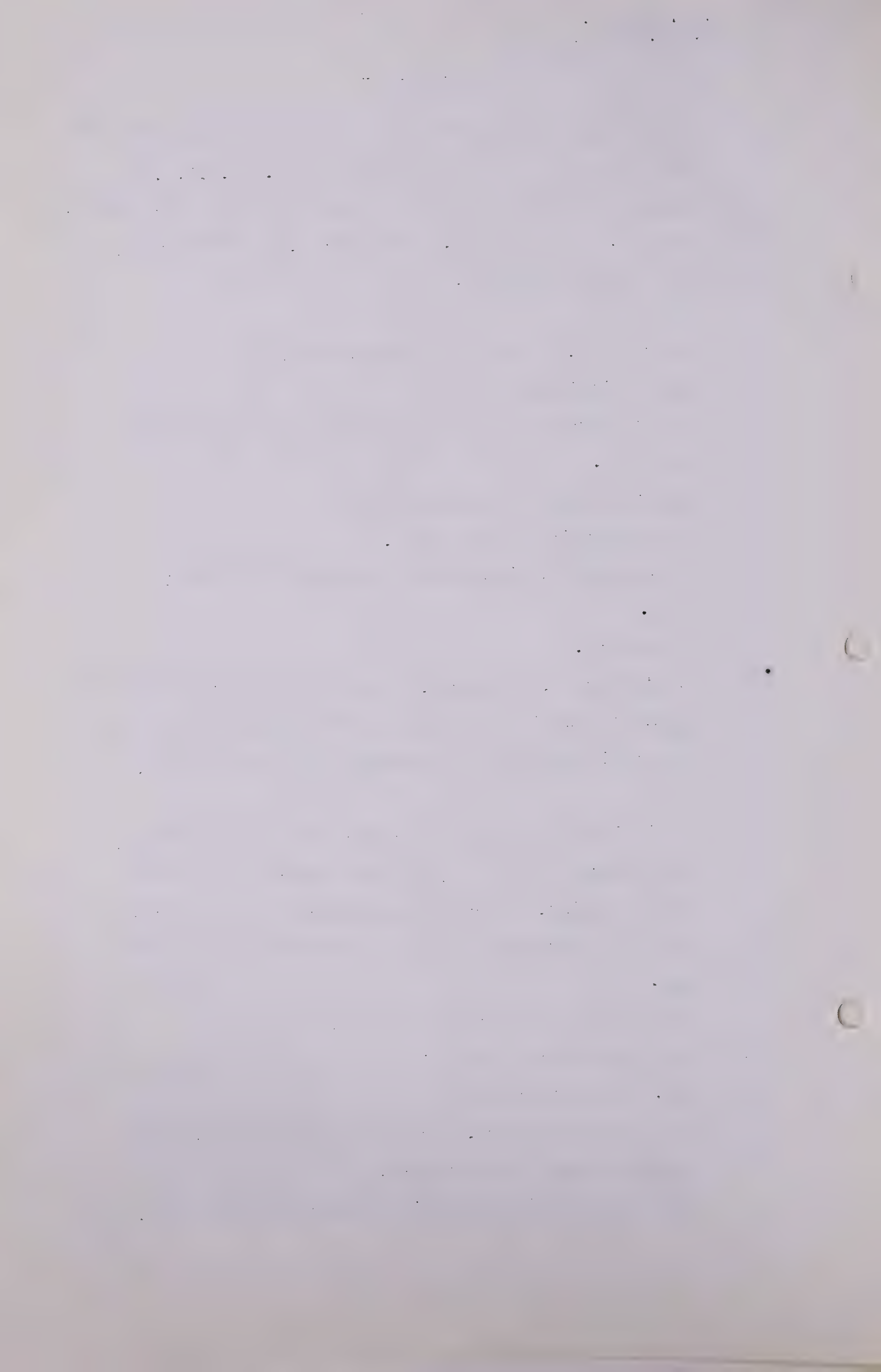
Q What would you get at 750 pounds?

A 750 pounds back pressure?

Q Yes, 750 back pressure?

A It would not produce, because the reservoir pressure has gone down to that figure.

Q What would be the reservoir pressure at that point, is



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it 600 or 500?

A At the last point you have mentioned?

Q Yes?

A Approximately 740 pounds, 750 pounds.

Q Just to make sure that I am right, Mr. Wilkins, this is well at the well head, gas at the well head before it enters the separator?

A This is high pressure separator gas.

Q Yes?

A But it is before extraction of the acid gases and the liquefiable hydrocarbons, which are not included in the condensate.

Q And that applies to all the answers you have given me on this particular question?

A Yes, sir.

Q Can you tell me how much gas in place is represented by the 1400 billion cubic feet I referred to?

A How much gas in place?

Q Yes? Raw gas in the formation?

A How much is remaining in the formation?

Q No, how much has been extracted when the 1400 billion reached the surface?

A Well, Mr. Gray gave the estimate that at the pressure of 100 pounds per square inch we would produce 1.65 trillion cubic feet of high pressure separator gas. Now, .. when we begin talking about that, that brings up another interesting point. When we begin talking about gas in the formation, I think Dr. Hetherington will agree with me that there is some question whether it is gas or what it is in the reservoir, because it is above the critical

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pressure, and it may be considered as a single dense phase, but not necessarily a gaseous phase.

Q What Dr. Hetherington wants to arrive at, Mr. Wilkins, is how he can relate the 1400 billion figure that I have given to raw gas in place? I suggest to you that we would arrive at something near his raw gas in place by multiplying that by the ratio of 1.65 against your 1.825?

A That 1.825 is meaningless.

Q That 1.825 is meaningless?

A Yes.

Q You do not think. . .

A As far as I am concerned. . .

Q Yes?

A . . . that does not enter into the calculations.

Q That does not enter into your calculations?

A No.

Q Well, I will leave it. Now, let me get at another point. As I understand, on this basis of calculation, you would not have reference to any regulations applicable to production of the gas?

A I do not think that it would be a rate sensitive, if that is what you mean.

(Go to page 1431)

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Exam. by Dr. Govier.

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Q If there was no difference after your percentage of open flow that you could see, you have not taken that into account?

A No, this is just theoretical of the 4-inch tubing, after having those cumulative volumes of gas and assuming that the well had an 18 million cubic feet per day theoretical open flow potential initially.

Q I am finished, thank you. I am sorry, Mr. Chairman.

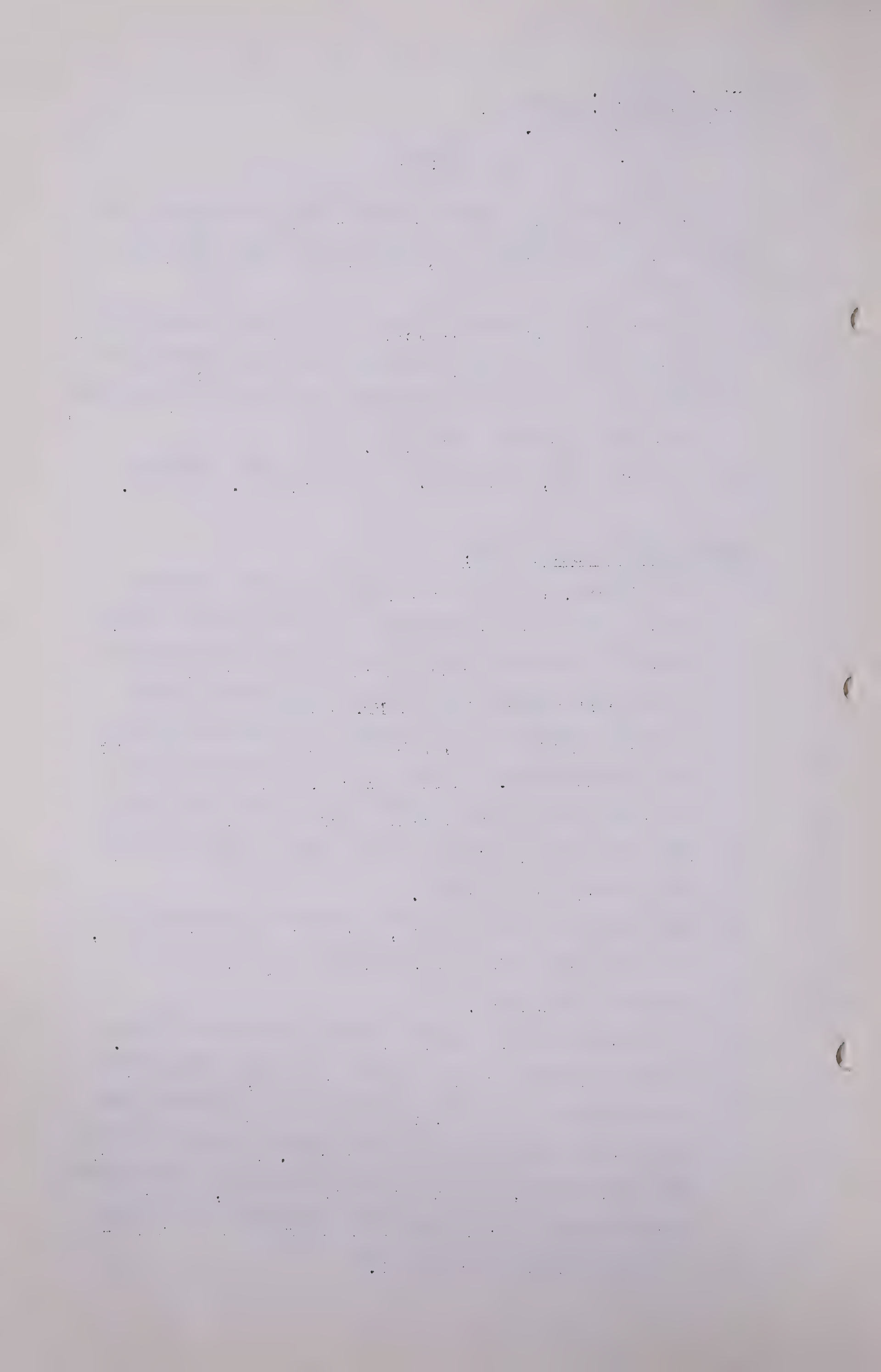
EXAMINATION BY DR. GOVIER:

Q Mr. Wilkins, I wonder if you would be good enough to express for me the percentage of gross reservoir fluid which reaches the surface which is represented by the 20 per cent figure given by Mr. Gray plus the little pressure separator gas, plus the gas volume equivalent of the condensate. In other words, I am asking you if you could give me an over-all surface shrinkage factor which would be applicable to the gross reservoir fluid which reaches the surface.

A That varies during the life, during the producing life, because of the change in the relative amount of the various constituents.

Q I appreciate that. I have in mind an average figure.

A If we remove all of the C₃ plus fraction, which won't necessarily be the case, that will be dictated by the economics of the plant and the market, and the recovery will be dictated, but the extraction losses, the C₃ plus fraction and the acid gases will average in the neighbourhood of about 19 per cent.



R. B. Wilkins,
Exam. by Dr. Govier.

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Q That means then if you brought 100 cubic feet of reservoir fluid to the surface, average reservoir fluid, that approximately 19 of those cubic feet would be represented by C_3 pluses and acid gas removal, is that right? This is on the average?

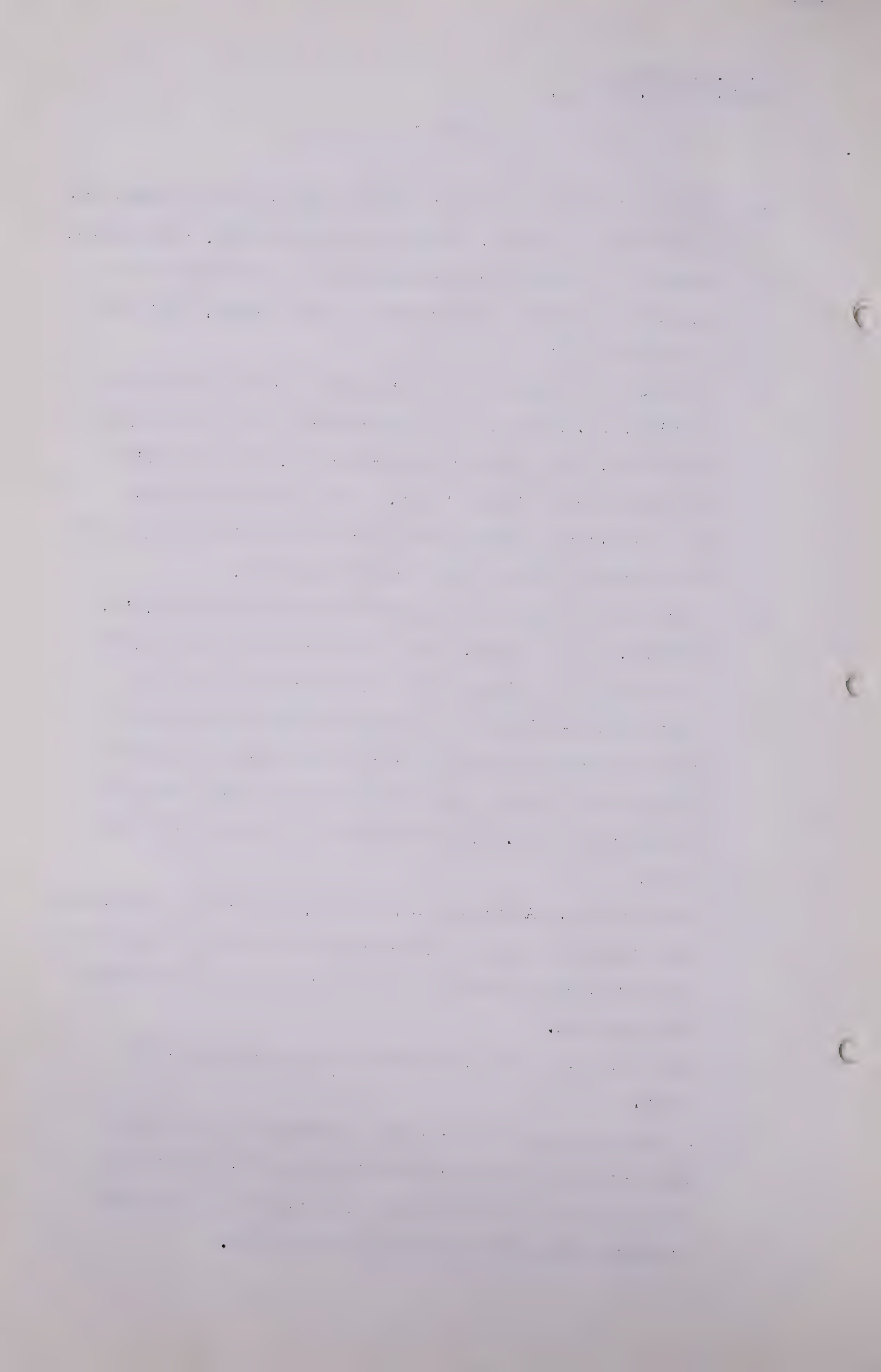
A I should have qualified my statement just a little bit further, Dr. Govier. I was speaking of the high pressure reservoir, high pressure separator gas, when I applied the 19 per cent figure to it. The condensate which we have already deleted from our reserve figures entirely and speaking entirely of high pressure gas.

Q I am trying to get you to speak on the other basis, Mr. Wilkins, if you would. What I am trying to do is find out whether the figures that the Board used of 30 per cent as over-all surface discount factor applicable to gross reservoir fluid produced at the surface is about the same as you are suggesting as 20 per cent there on a different basis. I am trying to get them to the same basis.

A That is true. Actually, Dr. Govier, if I may, in checking your figures I found that actually a figure of 25 per cent had been used although you said a figure of 30 per cent had been used.

Q That may be. I was assuming that the arithmetic was right.

A I think probably 25 per cent including the condensate and everything would probably be an applicable figure but I believe the 20 per cent as referring to the high pressure separator gas would be applicable.



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Exam. by Dr. Govier.

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Q So that you would suggest a 5 per cent difference between the figure referring to high pressure separator gas as compared to the figure referring to gross fluid?

A Yes, I think that would be reasonable.

Q You also suggest that the Board check its arithmetic. We would be very happy to do that.

MR. C.E. SMITH: We are really all poor people on arithmetic around here, apparently.

A Yes, that checks, it is 25 per cent.

THE CHAIRMAN: Thanks, Mr. Wilkins.

Gentlemen, I do not know whether you would rather adjourn now or try and clean up and not sit this afternoon.

It is immaterial to the Board.

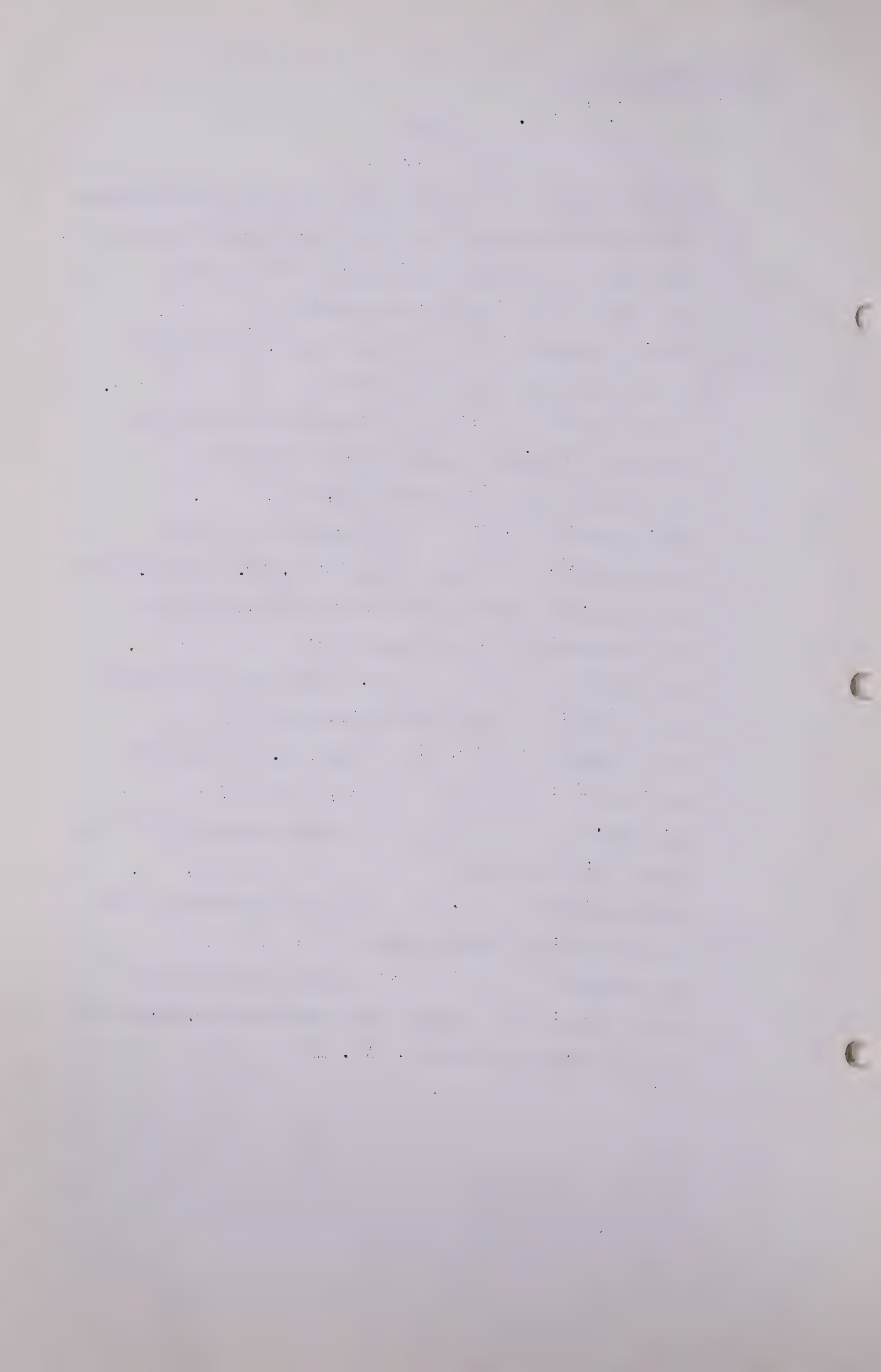
MR. FENERTY: Mr. McDonald indicated he might want to have Mr. Gray re-called.

MR. McDONALD: No, I am finished with Mr. Gray.

MR. STEER: I would suggest, sir, that we try and finish now.

THE CHAIRMAN: Is that agreeable? Are the Hudson's Bay people here?

MR. McDONALD: I understand Mr. Brown is not here, or Mr. Abbott. Mr. McMahon is present and we could dispose of him.



G. L. McMahon,
Dir. Ex. by Mr. McDonald.

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GEORGE L. McMAHON, having
been first duly sworn, examined by Mr. McDonald, testified
as follows:

Q Mr. McMahon, would you be good enough to read the sub-
mission, which is to be marked.

SUBMISSION OF PACIFIC PETROLEUMS
LIMITED, CANADIAN ATLANTIC OIL
COMPANY LIMITED and PEACE RIVER
NATURAL GAS COMPANY PUT IN AND
MARKED EXHIBIT 41.

A It is entitled, "A Submission to the Petroleum and Natural
Gas Conservation Board by Pacific Petroleum Limited,
Canadian Atlantic Oil Company Limited and Peace River
Natural Gas Company Limited."

Dear Sirs:

Pacific Petroleum Ltd. commenced operations
in Alberta in 1938, and the other companies of the
Pacific group, namely, Canadian Atlantic Oil Company
Ltd. and Peace River Natural Gas Company Ltd., came into
being in 1945 and subsequently. To date this group of
companies and associates have spent in Alberta
\$11,300,000 for the purchase of Crown leases and
\$11,000,000 for exploration, drilling and equipment,
making a total of \$22,300,000. These figures exclude
the cost of private leases.

We have drilled a total of 156 wells in
Alberta covering 21 areas of the Province. This drilling
resulted in 111 completed oil wells and 15 gas wells.
In British Columbia 15 wells have been drilled, resulting
in seven completed gas wells.

As will be noted below in the acreage figures,

G. L. McMahon,
Dir. Ex. by Mr. McDonald.

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our companies have been prominent in the development of the northern areas. In fact, we might be considered as pioneers in the area, by virtue of having received the first exploration permits in recent years and having been in the forefront of exploration in northwestern Alberta.

At the present time, Pacific Petroleums Limited, Canadian Atlantic Oil Company Ltd., and Peace River Natural Gas Company Ltd., and associates, are the holders of permit and Petroleum & Natural Gas leases and reservations exceeding 5,500,000 acres in Alberta and British Columbia. Of this total, more than 2,500,000 acres are in Northwestern Alberta and more than 2,000,000 acres are in Northeastern British Columbia. A map is enclosed showing the Northern holdings.

These large acreage holdings were acquired and substantial expenditures in exploration and development both for gas and oil have been made relying upon the prospect of an early market for gas through the proposed pipeline of the Westcoast Transmission Company Limited.

To date the Companies have drilled 36 wells in the northern area, of which 16 are successful gas wells. Under these circumstances I think we may be considered as being vitally interested in this hearing and in the possibility of early export. Our experience and expenditure in drilling for gas in the Province exceeds that of any other independent operator.

As stated at the Joint Hearing last year, our companies will undertake, insofar as they are called upon,

G. L. McMahon,
Dir. Ex. by Mr. McDonald.

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to do sufficient drilling to prove up the reserves and provide the necessary deliverability for the Westcoast Transmission Company's projected pipeline. We certainly believe that the area can and will produce, under export stimulus, almost limitless gas reserves, and certainly more than the necessary reserves for the pipeline. It is interesting to note that some 20 wells are being currently drilled and 30 geological crews are operating in the Peace River region. In addition to the nine discoveries or fields already existing, there are a number of other very interesting gas occurrences - such as at Imperial Royce, Imperial Girouard, Imperial Magliore, Pacific Dunvegan, Pacific Highland Park, Bear Villa, Bear Driftpile, etc., which are infinitely significant in that they show how wide-spread is the potential gas production of the area. We are of the opinion that a number of other possible discoveries or important showings have been "muddled" off as discussed in Dr. Dodge's submission for Westcoast. This would be particularly true of wells drilled in the period up to two years or so ago when gas was not as important for its own sake.

Since the Joint Hearing, and particularly since the Alberta Government amended the regulations to provide greater incentive for gas exploration, we have employed six drilling rigs almost continually in the northern area. These rigs were utilized on our companies' own acreage and on lands obtained by farmouts from other companies. In order to speed up the development of reserves we have approached every company that has made

G. L. McMahon,
Dir. Ex. by Mr. McDonald.

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a discovery with offers to drill under farmout or other agreement. Four such agreements have been concluded with others being negotiated, and our companies stand ready to continue this procedure.

Our present programme in the northern part of the two Provinces includes the operation of two geo-physical crews, surface geological parties, together with the continuous operation of four to six drilling rigs.

It is a matter of record that practically all major Companies operating in Canada have acquired extensive holdings and are expending substantial amounts in the Peace River areas of Alberta and British Columbia. While the development of this area is new compared to the rest of the Province of Alberta, the rate of gas discoveries per number of wells drilled, compares more than favourably with the records in the other parts of the Province. The added stimulus of gas export will materially assist in this development and this group of Companies at least will accelerate their program in the exploration and development of both oil and gas reserves.

Respectfully submitted,

PACIFIC PETROLEUMS LTD.

George L. McMahon,
Vice-President.

Q Mr. McMahon, you have attached to your exhibit the map you refer to. I have opened one up here?

A Yes.

Q And this exhibit, Mr. McMahon, shows the holdings of Pacific Petroleum and Associates in its own right,

G. L. McMahon,
Dir. Ex. by Mr. McDonald.
Cr. Ex. by Mr. Nolan.

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Imperial Oil Limited farm-outs, farm-outs from the
Hudson's Bay Oil and Gas Company, etc.?

A That is right.

Q The farm-outs are located generally in the area that has
been described as a source of gas to the Westcoast Company?

A That is right.

CROSS-EXAMINATION BY MR. NOLAN:

Mr. Chairman, I wanted to ask Mr. McMahon a few question,
if I may, please.

Q Mr. McMahon, I observe that this Exhibit 41 is submitted
by three companies, Pacific Petroleums Limited, Canadian
Alberta Oil Company Limited --

A Canadian Atlantic Oil Company Limited.

Q Canadian Atlantic Oil Company Limited and the Peace River
Natural Gas Company Limited. Mr. McMahon, is Pacific
Petroleums a Provincial company?

A It is a British Columbia company.

Q It is a British Columbia Company registered in Alberta?

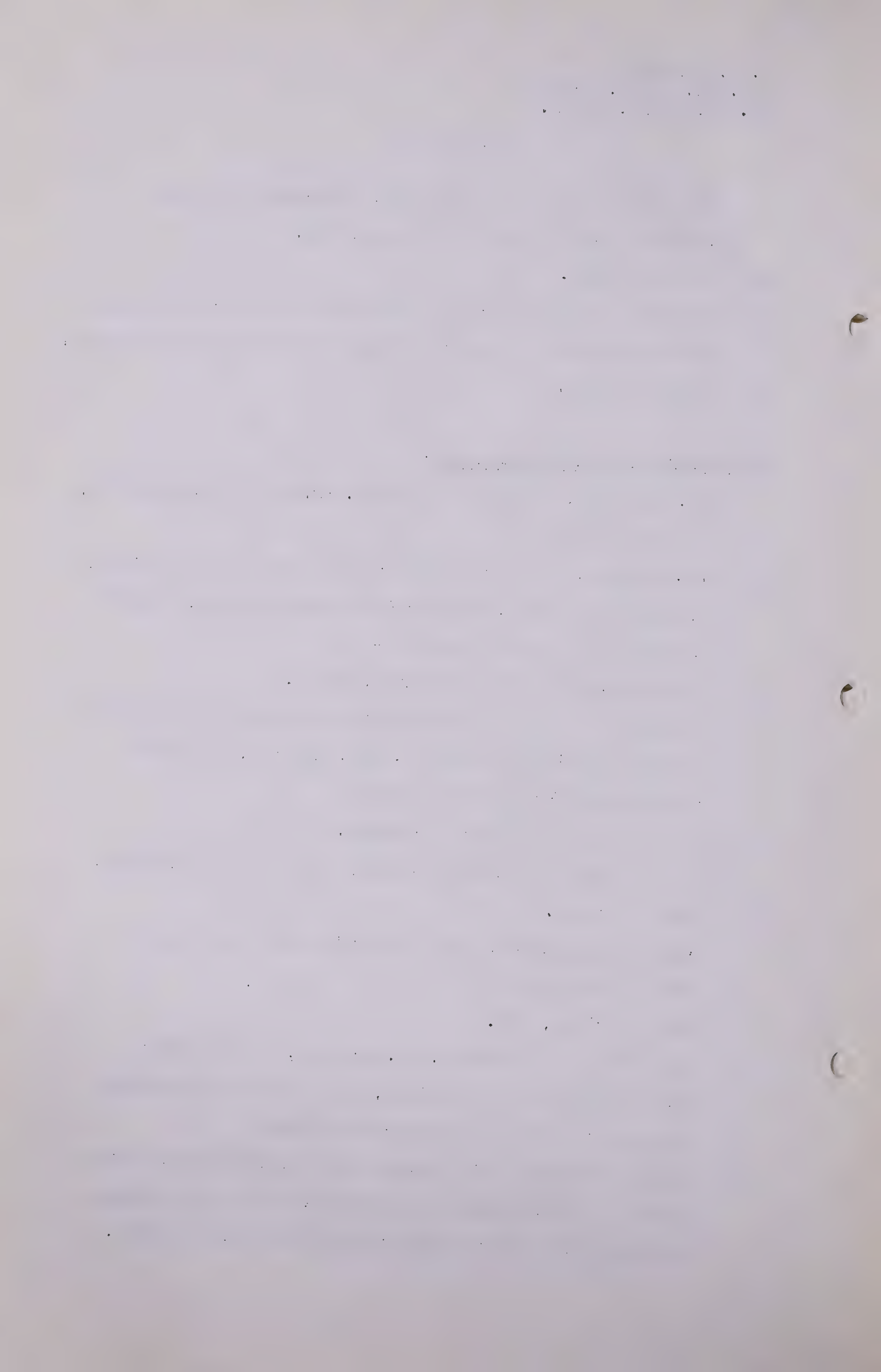
A That is right.

Q And it is engaged in the exploration and development of
both oil and gas?

A That is right, sir.

Q Then the second company, Mr. McMahon, the Canadian
Atlantic Oil Company Limited, what is that? Has that
some relationship to Pacific Petroleums?

A Canadian Atlantic Oil Company is an amalgamation or the
result of an amalgamation between Atlantic Oil Company,
Allied Oil Producers Limited and Princess Petroleums.



G. L. McMahon,
Cr. Ex. by Mr. Nolan.

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Q Is it a separate and distinct entity from Pacific
Petroleums?

A Yes, sir, except Pacific Petroleums is a very large share-
holder.

Q Is a controlling shareholder?

A At the moment, yes.

Q Then the Peace River Natural Gas Company, I take it from
the name of that company it was organized for the purpose
of exploring and developing gas reserves?

A That is right, sir.

Q And has it any relation to the Pacific Petroleums Limited?

A In somewhat the same way but not to the same extent.

Q Pacific Petroleums is a majority stockholder?

A No, sir.

Q It has a large holding in the company but it does not
control it?

A That is right.

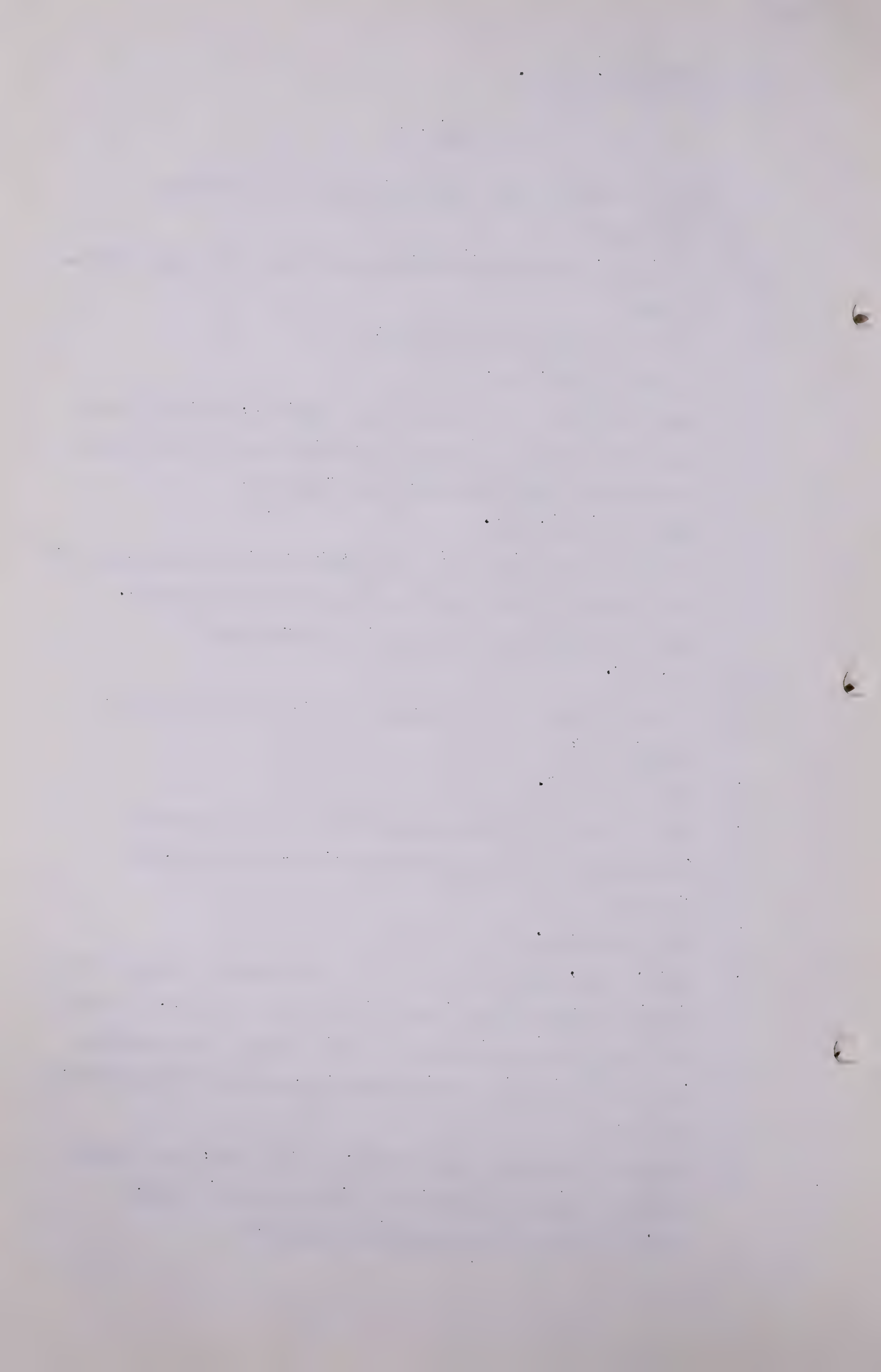
Q And is there any relationship between the Canadian
Atlantic Oil Company and the Peace River Natural Gas
Company?

A None whatever.

Q Well, then, when we come to the relationship between these
companies and the Westcoast Transmission Company, perhaps
you would tell me what that relationship is as between
Pacific Petroleums Limited and the Westcoast Transmission
Company?

A Pacific Petroleums Limited was, I might say, the organ-
izer or sponsor of Westcoast Transmission Company.

Q Yes. And what is the relationship now?



G. L. McMahon,
Cr. Ex. by Mr. Nolan.
Cr. Ex. by Mr. Bredin.

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A Still the same.

Q Well, does Pacific Petroleums control the Westcoast Transmission?

A No, sir.

Q Does the Westcoast Transmission control Pacific Petroleums?

A No, sir.

Q Well, is it a stock interest of one company in the other?

A At the moment, I think that is correct.

MR. McDONALD: Pacific Petroleums has a stock interest.

A Pacific Petroleums has a stock interest, yes.

Q MR. NOLAN: Pacific Petroleums has a stock interest?

A Yes, sir.

Q Is that a controlling interest?

A At the moment, it is, yes.

Q So that Westcoast Transmission at the moment is controlled, as I understand you, Mr. McMahon, by Pacific Petroleums Limited?

A Yes, sir.

Q Thank you, Mr. McMahon.

CROSS-EXAMINATION BY MR. BREDIN:

Q Mr. McMahon, have you developed supplies or reserves at this moment capable of supplying, say, the Vancouver market from the Peace River area?

A We could not say we have done that all ourselves, no, sir.

Q In that area you are satisfied that there are sufficient reserves to satisfy, say, the Vancouver market?

G. L. McMahon,
Cr. Ex. by Mr. Bredin.
Discussion.

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A Very close to that point. That has been submitted in evidence here before.

MR. McDONALD: You say the Vancouver market as apart from the other markets in the Pacific Northwest?

MR. BREDIN: I was taking Vancouver itself.

THE WITNESS: Vancouver itself, yes.

Q MR. STEER: It is not financially feasible to carry it to Vancouver alone, is it?

A No, sir.

MR. McDONALD: Mr. Chairman, Mr. Brown and Mr. Abbott of the Hudson's Bay Company were here a few minutes ago. I attempted to catch them by telephone.

MR. C.E. SMITH: Everybody is agreeable. Why not mark their exhibit.

MR. McDONALD: That would do for the moment, sir, then at the commencement of our next proceeding maybe we could call the witnesses and make their explanation.

MR. STEER: Why don't you mark it and read it yourself and let us have copies of it.

MR. McDONALD: No, I would not go that far. I have copies of it for everyone and it could be marked.

THE CHAIRMAN: We could mark it now.

SUBMISSION OF HUDSON'S BAY
OIL AND GAS COMPANY LIMITED
PUT IN AND MARKED EXHIBIT 42.

MR. C.E. SMITH: Before you rise, I wonder if Mr. Wilkins is still here. If he is not, I think I

Discussion.

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should on short enquiry like to take issue with him that you used the wrong arithmetics. I imagine he is gone.

MR. MAHAFFY: We did not catch your last remark about receiving this as an exhibit.

THE CHAIRMAN: Mark it and hear the witness on the adjournment. Did I understand you to say that those calculations have been checked which Mr. Wilkins referred to with regard to Pincher Creek?

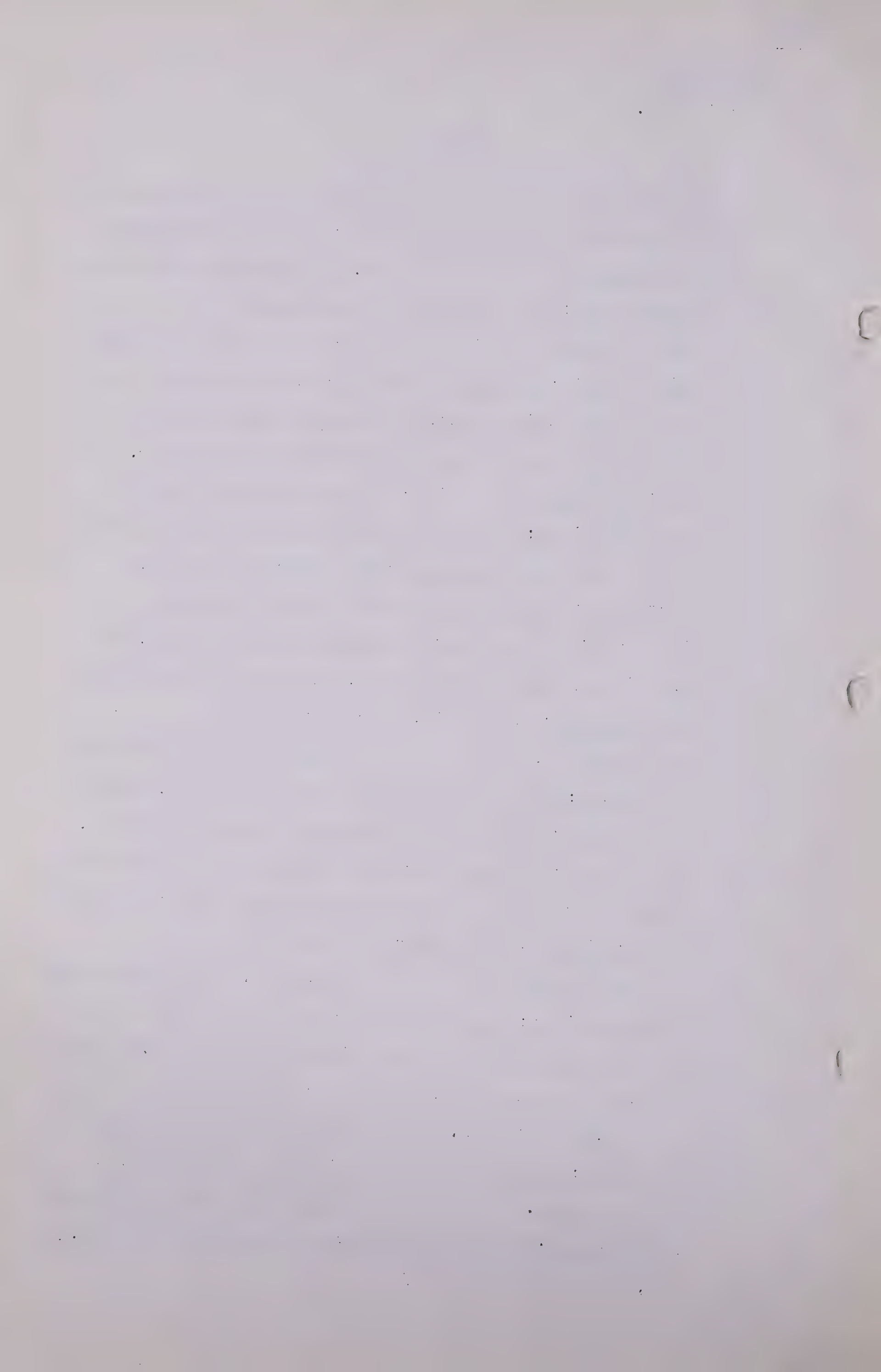
MR. C.E. SMITH: Yes, we checked them as fast as we could when we heard this and I suggest, subject to somebody cross-examining somebody else, that the Board's mathematics at 30 per cent is correct. That is why I wanted to ask Mr. Wilkins how he did it and how he arrived at it. I do not think I need bother at the moment.

DR. GOVIER: It may be that Mr. Wilkins has misinterpreted the headings of some of the columns. The 30 per cent figure that appears in column 13 is a figure which should be used to multiply the figure which appears in column 10 after it has already been multiplied by the figure that appears in column 12.

MR. C.E. SMITH: That may be the explanation. I thought if he were here we might find that out. I did not want to leave it on the record as it was left by Mr. Wilkins, that is all.

MR. STEER: It would be some comfort to some of us.

MR. McDONALD: Before the Board adjourns, sir, I have four copies just delivered from the printers



Discussion.

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of a submission in the nature of natural gas in the economy of Alberta and British Columbia on behalf of Westcoast Transmission Company Limited.. This is quite a voluminous document and I do not suggest we put it in evidence or call witnesses, but I am going to deliver it to the Board and counsel and on October 29th you can consider what you want to do with it. Counsel will have them as soon as they can be delivered from the printer.

SUBMISSION "NATURAL GAS IN THE
ECONOMY OF ALBERTA AND BRITISH
COLUMBIA" ON BEHALF OF WESTCOAST
TRANSMISSION COMPANY LIMITED
PUT IN AND MARKED EXHIBIT 43.

THE CHAIRMAN:
29th of October.

We will adjourn until the

(The Hearing then adjourned until
Monday, October 29th, 1951.)

Director

Dear Sir

On a preliminary view of the nature of the subject, it is the
policy of the Government and British Columbia to limit the
number of persons who may be admitted. This is done
by a system of permits and I am not aware that we are to
be allowed to admit any more, but I am going to do so in
the future and covered and on October 21st we are
considering what you want to do with it. I am not sure
that we can do that and be satisfied with the result.

SUBMISSION OF MATERIAL IN THE
FORM OF A REPORT AND REPORT
ON THE BASIS OF RESEARCH
CONDUCTED BY THE
BUT IN THE FIELD OF RESEARCH

We will report until the

THE OFFICE

29th of October

(The meeting then adjourned until
Monday, October 29th, 1907.)

The Province of Alberta

PETROLEUM AND NATURAL GAS CONSERVATION BOARD

Application for Permission to Remove or cause to be removed
Natural Gas from the Province of Alberta, under the Provisions of the
Gas Resources Preservation Act by Prairie Pipe Lines Limited.

I. N. McKinnon Esq., Chairman

D. P. Goodall Esq.

Dr. G. W. Govier

Session:

Volume_____

